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How Do Planners Participate in Formulating Viable Green Infrastructure Plans?

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HOW DO PLANNERS PARTICIPATE IN FORMULATING VIABLE GREEN INFRASTRUCTURE PLANS?

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ABSTRACT

The planning field is increasingly involved in balancing biodiversity with the expansion of urban areas to meet changing societal demands. Regions, states and cities have begun trying to mitigate the negative effects of sprawl by creating green infrastructure plans to conserve open space. However, little is known about planners' roles in facilitating and/or implementing these visions in cities with a population of over one million people in the core and hinterlands. The goal of this project was to study the Chicago Wilderness Green Infrastructure Vision to determine if planners played a role in its formulation and/or implementation, and if so, to what extent. Also of interest was whether they contributed to making the plan viable from a biodiversity standpoint. The overarching goal of this research was to create a research framework that would uncover how planners both aid and fail in creating and perpetuating viable green infrastructure visions, with applicability to other large cities. Although no correlations were discovered, data suggests that planners do have a role in the Vision's formulation and implementation and that role most commonly occurs through drafting of area comprehensive plans that promote private conservation approaches and open space land designation. Furthermore, it was found that the Chicago Wilderness Green Infrastructure Vision was designed to promote the continuation of biodiversity, rather than recreation purposes by constructing a gap analysis to evaluate lands identified as potential green infrastructure hubs and corridors.

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INTRODUCTION

A major concern in the planning field is the preservation of open space in the face of rapid development. Margules & Pressey (2000) stated, “It is an ancient and widespread human practice to set aside areas for the preservation of natural values. The sacred groves of Asia and Africa and royal hunting forests are historic examples” (p. 243). But there are several factors that determine the effectiveness of habitat conservation approaches in urbanized areas.

Ensuring biodiversity in natural spaces is essential to the protection and health of ecosystems. Providing habitat connectivity to assure that species can freely live, eat and breed contributes to the viability of their populations. But how do we assure that both of these things can be maintained in highly urbanized areas? In attempting to maintain biodiversity and species populations, cities have started to implement green infrastructure visions into their planning goals.

However, little is known about how effective green infrastructure visions have been in cities with populations of over 1 million residents in their cores and hinterlands. Furthermore, of the green infrastructure visions that are beginning to come to fruition, little has been done to assess whether green spaces have been designed with biodiversity and habitat connectivity in mind, or if they are more anthropocentric in their conception. Finally, planners’ roles in realizing these approaches have not been studied in great detail, particularly in the United States.

Therefore, it is the purpose of this research to review the concepts of biodiversity, habitat connectivity and green infrastructure approaches of all sizes and components to begin to ascertain whether green infrastructure visions in the United States provide a more biocentric or species functional purpose, an anthropocentric or structural purpose, or both. This research will also focus on how green infrastructure and open space preservation relate to the planning profession. It answers the following questions: what roles do planners play in creating green infrastructure visions in regions with a highly urbanized city that has a population of over one million people, and if they play a role, do they contribute to making it a viable green infrastructure approach?

SUSTAINABILITY IN URBAN AREAS

As described by Meppem (1998), the World Commission on Environment and Development defined sustainability as "development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs'" (p. 123). Developing strategies to conserve for future generations is becoming a larger part of land use planning in modern times and a focus on planning and sustainable development interests governmental bodies (Owens, 1994, p. 439). This is directly related to land use and development as far as environmental impacts.

Sustainability is also becoming an increasingly popular topic in large cities as well. In fact, "many aspects of sustainable development are best addressed

at the metropolitan regional scale" and can have positive effects specifically on land use, transportation, air and water quality, ecosystem protection, affordable housing options and social equity (Wheeler, 2000, p. 133). As these approaches are growing more population, there are questions about the involvement of planners in helping them come to fruition (Wheeler, 2000, p. 133). There are historic examples of sustainability concepts in planning from people including Ebenezer Howard, Patrick Geddes, Lewis Mumford, Jane Jacobs, Ian McHarg and Kevin Lynch in their interest in the formation and protection of environmentally sensitive lands within urban areas (Wheeler, 2000, p. 135).

Sustainability also includes the ideas of initiating compact development and preserving sensitive environmental areas, which are concepts that are increasingly being touted in the planning profession. It is related to urban planning because it promotes reduced automobile use, reduced waste and pollution, reuse, community-oriented spaces, affordable housing and equal opportunities within local economies (Wheeler, 2000, pp. 134-135).

It is a concept that also includes several facets of environmental conservation. It seeks to preserve biodiversity by including the preservation of sensitive environmental areas as one of its main concepts. In this way it also becomes linked with habitat corridors and subsequently, green infrastructure visions. It is clear planners are involved in sustainability concepts, but unclear if they participate in action plans like green infrastructure approaches with the concept of biodiversity in mind.

BIODIVERSITY

Principles

Biodiversity guides both green infrastructure visions and habitat connectivity and ties them together. It has been stated that the components of green infrastructure visions promote the preservation and richness of ecosystem biodiversity through habitat protection. Likewise, the biodiversity of habitats are almost always directly related to the accompanying ecosystem's functions (Tzoulas, et al., 2007, p. 170).

Habitat connectivity is essential to mitigating habitat destruction and fragmentation, which are the two major causes of biodiversity loss. While habitat destruction removes availability of land, fragmentation also reduces actual habitat acreage and isolates remaining habitat, which greatly jeopardizes the viability of species populations genetically, environmentally, and demographically, as documented in studies from North America and Africa (Crooks & Sanjayan, 2006, pp. 7-9). Furthermore, urbanization typically fosters the propagation of select species, often invasive, and negatively affects biodiversity (Miller, 2005, p. 431). Finally, it has been stated by many experts that habitat connectivity approaches like green infrastructure undoubtedly aid in the protection of species and important lands (Crooks & Sanjayan, 2006, p. 9). However, the social goals of green infrastructure are not always compatible with its biological goals because structural connectivity can have disadvantages that potentially outweigh its benefits (Donald & Evans, 2006, p. 211).

Theories

Biodiversity, in addition to being a guide for habitat connectivity and green infrastructure visions, has several theories that attest to its benefits. These include social health, human health, the health of the economy, and the importance of the concept to the planning profession today. These theories are described in the following sections.

Societal Needs

Biodiversity conservation is important to communities, not only because they need to be provided with avenues of interaction with nature to encourage environmental awareness, but to enhance the well-being of society and alleviate the estrangement of people from nature, as well (Miller, 2005, p. 430). It is important to utilize the exchanges between society and nature rather than to assume that people should be managers of the environment. In doing so, the human community can aide in gaining more pure and complete information than from research studies exclusively, effectively participating in citizen science (Berkes, 2004, p. 623). The Heritage Conservancy also cites the social fabric of a community and its relationship to the surrounding natural region as an important consideration for the creation of a green infrastructure system (Williamson, 2003, p. 6).

Therefore, increasing the biodiversity of communities may have the potential to increase the social capital of those areas. Through a more pure and diverse ecosystem, knowledge is gained and communities are enriched by their

connection to nature. These social relationships are a large consideration in the drafting of green infrastructure visions and the planning profession as a whole.

Human Health

The lack of open space in urban and suburban developments creates many health issues including childhood obesity from lack of outside activity. In fact, “evidence increasingly supports that human fitness relies on a matrix of instrumental connections to natural features and processes” (Baldwin, Powell & Kellert, 2011, p. 323). A recent study cited in Miller (2005) showed that an average child spends less than one hour per day outside, a drastic decrease from just a few decades ago. Furthermore, inside activity is often stationary, with the average child watching more than four hours of television on a daily basis. These results have significant negative effects on the mental and physical health of youth (Miller, 2005, p. 431).

Natural ecosystems serve an extremely important role in maintaining human health because of their ability to provide food, water, and clean air. These systems also provide important health functions such as purifying air and water and breaking down wastes and toxins on land and at sea through wetland filtration systems and carbon sequestering. As described by Melillo and Sala (2002), “ecosystems provide the life support systems for all life, including human life, on Earth” (Chivian & Bernstein, 2004, p. 12).

A “greater integration of nature and the built environment not only has the potential to foster support for preserving biodiversity and to create opportunities

for native species, but also to better the human condition" (Miller, 2005, p. 432). An example of this would be that research shows high-order cognitive functioning has a relationship to direct and indirect contact with the natural world (Miller, 2005, p. 432). Biodiversity and the services that are rendered through green infrastructure visions can often result in healthier populations physically, psychologically and environmentally (Tzoulas, et al., 2007, p. 175). However, "the great majority of the urban public, decision-makers, and developers remain largely indifferent and incognizant of the value of a healthy and diverse natural environment in the modern city" (Kellert, 2004, p. 9). Therefore, it has been suggested that biodiversity is related to the improvement of human health and should also be a consideration in the planning profession.

Economy

A major challenge in today's conservation movement is managing economic growth while still maintaining biodiversity and healthy species populations (Yellowstone to Yukon Conservation Initiative, 1998, p. 55). The healthier and more diverse environments are, the more contributions they make to the socio-economic standing of their areas (Tzoulas, et al., 2007, p. 175). The growing popularity of ecotourism is a good example of this. Areas with more biodiversity would naturally be a more attractive destination for tourists, which would bring more money into local economies and should be considered in comprehensive plans where applicable.

The Planning Profession

Examples of the need for increased awareness of biodiversity in planning are abundant. Some of these include the persistence of conflicting and uncoordinated management and land use practices that ignore negative effects on the ecosystem, the lack of understanding of agencies about how the regional economy affects the persistence of species and habitat, and the ill-effects of varying approaches and policies that negatively affect successful conservation management approaches (Yellowstone to Yukon Conservation Initiative, 1998, p. 138). Furthermore, conservation planning has historically not taken a systematic approach, which leads to the fragmentation of protected areas and the loss or lack of biodiversity on conserved lands (Margules & Pressey, 2000, p. 243).

Systematic conservation planning is an example of the connection of biodiversity to the planning profession. It necessitates the careful consideration of biodiversity surrogates, as well as clear, quantitative goals. It evaluates past conservation goals in addition to utilizing several tools that allow for a better selection of conservation lands, and provides the criteria for those selections. Finally, it chooses adaptive management techniques to maintain the land's quality and richness (Margules & Pressey, 2000, p. 243).

Adopting these concepts, "green infrastructure is an emerging idea about how urban forests and green spaces can optimally generate benefits in cities using systematic planning, design and management of trees and other living materials" (Wolf, 2003, p. 4). Planning for green infrastructure is, however, different from typical open space planning in that it considers human and

economic needs such as land development, growth management and infrastructure planning (Benedict & McMahon, 2002).

Although it is important to consider wildlife and human needs, it is also essential to allow for human uses that do not impede on biodiversity; the integrity of the ecosystem and management is the most important factor in maintaining this balance (Yellowstone to Yukon Conservation Initiative, 1998, p. 7). Roads that both fragment and connect the human population to pristine natural habitats pose significant threats to wildlife populations and movement (Craighead, 2002, p. 2). Therefore, transportation planning is an integral part of mitigating habitat fragmentation and promoting biodiversity maintenance. "Considering the high degree of disturbance caused by the current level of human activities to wildlife species and habitat near existing transportation routes, any incremental increase in negative impacts, short-term or long term, such as additional roads, developments, or resource extraction will have the cumulative effect of reducing wildlife habitat" (Craighead, 2002, p. 3).

This also fits into a new transportation planning concept of road ecology, which treats roads as wildlife corridors and recognizes their importance in shaping conservation areas. One goal of this theory is to make roads more suitable for wildlife crossing, which would therefore protect the landscape connectivity (Forman, et al., 2003, p. 167). "Roads can be barriers to (1) the efficient drainage of flood water, (2) the encroachment of water during high water levels, and (3) the natural flow of water" and "they also commonly dissect shallow

surface water into separate water bodies" (Forman, et al., 2003, p. 190). While Australia's transportation policy has a focus on biodiversity, the U.S. policies focus specifically on air pollution and give little attention to biodiversity and habitat fragmentation (Forman & Alexander, 1998, pp. 223-224). Road ecology seeks to change this perspective by developing better road corridors that are more tailored to the propagation of wildlife.

Road corridors are considered the road surfaces, as well as maintained roadsides and maintained landscaping. They have the potential to serve as conduits, barriers, habitats, sources, and sinks depending on their width, connectivity levels and how often they are utilized by wildlife (Forman & Alexander, 1998, p. 208). This concept is important to consider when creating large-scale conservation networks so that roads are designed with cognizance of biodiversity preservation. Otherwise, "Biodiversity erodes as the road network impacts interior species, species with large home ranges, stream and wetland species, rare native species and species dependent on disturbance and horizontal flows" (Forman & Alexander, 1998, p. 221). This concept of connectivity's importance to maintaining biodiversity will be explored further in the following section.

HABITAT CONNECTIVITY

Principles

Habitat Fragmentation

Wilcox and Murphy (1985), as described by Collinge (1998), define habitat fragmentation as loss of habitat and isolation of habitat and species (Collinge, 1998, p. 158). Because of this, "[f]ragmentation [also] significantly affects landscapes in many critical ways, including resource availability, environmental degradation, and recreational and aesthetic quality" (Benedict & McMahon, 2006, p. 9). As such, landscape architects and planners have had to become increasingly more involved in land conservation as it relates to biodiversity (Collinge, 1998, p. 157).

In planning for biodiversity within green infrastructure visions, comprehensive planning approaches are integral according to the Heritage Conservancy (Williamson, 2003, p. 15). "Planners and conservationists often ask how wide corridors need to be, and corridor widths (especially for riparian corridors) are often specified in land-use plans" (Noss, 1987, p. 163). Therefore, planning is becoming undeniably important to biodiversity maintenance and visa versa.

This has changed the status quo. Until recently it was thought that protecting large hubs for wildlife habitat would suffice but it has become apparent that corridors and connectivity are also extremely important to consider (Benedict & McMahon, 2006, p. 111). By creating connections, conservation land can avoid the barrier effect, which essentially increases the fragmentation of core

populations, leading to a metapopulation structure, and eventually complete isolation (Forman & Alexander, 1998, p. 218). This can create risks for endangered and threatened species, 95 percent of which are considered threatened because of habitat loss and fragmentation (Benedict & McMahon, 2006, p. 9).

Many authors have stated that habitat fragmentation is the leading cause of smaller, more isolated species populations, which therefore lead to more local extinctions during extreme environmental events and inbreeding (Yellowstone to Yukon Conservation Initiative, 1998, p. 113). Fragmentation is prevalent when conservation land is adjacent to areas such as clear-cut land, cultivated grasslands, linear corridors and roads and any other developed land. This has been widely identified as a having a negative effect on the population viability of large carnivores such as grizzly bears (Yellowstone to Yukon Conservation Initiative, 1998, p. 67).

Furthermore, the connectivity of habitat is decreasing non-linearly with the loss of species habitat. Consequently, any loss of natural habitat can fragment wildlife corridors and their connections to contiguous patches (Hanski, 1999, p. 216). Although planners are becoming more involved in creating designated green spaces, it is questionable whether connections in those spaces are considered and whether the land itself has a biocentric or anthropocentric focus, especially in large cities. Despite the continued loss of habitat, maintaining connectivity in highly urbanized areas could potentially aid in its mitigation.

Functional and Structural Lands

The concept of functional and structural conservation land is an important aspect of habitat connectivity. Structural connectivity is based on the spatial amount and structure of habitat approaches with little or no deference to the needs of the native species as far as movement, cover and food sources. Functional connectivity requires the aforementioned considerations but also incorporates the movement of species throughout the habitat into account (Crooks & Sanjayan, 2006, p. 3).

Structural Connectivity

Structural connectivity is easier to quantify than functional connectivity, however, those measurements often do not apply across landscapes or species and may only be considered functional for some species of the habitat area and not others (Crooks & Sanjayan, 2006, p. 3). It is often anthropocentric, prioritizing human needs over the needs of native species.

Functional Connectivity

Conservation biologists tout functional connectivity as an essential tool in creating conservation approaches. As described by Crooks and Sanjayan (2006), Fagan and Calabrese (2004) categorize functional connectivity into two types: potential connectivity and actual connectivity. Potential connectivity supplies vague information about the ability of movement that organisms possess in a given range while actual connectivity describes the existing migration of specific organisms through a given range, providing direct information for estimation (Crooks & Sanjayan, 2006, p. 3).

Theories

"The term landscape connectivity should be reserved for its original meaning, i.e., the degree to which the landscape facilitates or impedes movement along resource patches" (Tischendorf & Fahrig, 2000, p. 16). The free movement of species populations is important to consider when creating an open space plan. However, achieving connected patches of natural space that prevents fragmentation is a complicated process. Conservationists do not easily define connectivity or the benefits that it would provide and largely ignore the economic costs that it may have (Crooks & Sanjayan, 2006, pp. 1-2). Though landscape ecologists and conservation biologists both understand the importance of providing habitat connectivity to maintaining biodiversity, they should focus more attention on providing interactions with civilization and its natural world by formulating a network of preserved lands near where people live and do business (Miller, 2005, p. 433).

Green infrastructure, with its emphasis on human functions, seeks to reduce the separation of people from their natural environment. However, in achieving this, the approaches risk focusing on more green social spaces, rather than functional habitat spaces for wildlife. It is unclear how to best construct these spaces and around which species to center the structure.

Literature Gaps

Although it is hardly refuted that habitat connectivity is becoming an increasingly popular aspect of land management approaches throughout the

world, the definition of connectivity is a vague collection of related ideas (Crooks & Sanjayan, 2006, p. 2). Furthermore, “landscape architects and planners are increasingly involved in projects aimed explicitly at conserving, enhancing, or restoring biological diversity” (Collinge, 1998, p. 157). However, it is not known whether planners in general apply habitat connectivity concepts to these projects.

There are also issues with public vs. private land and different approaches are numerous (Hilty, Lidicke, & Merenlender, 2006, p. 25). The problem lies in the lack of clarity on how to scientifically quantify a connectivity scheme in a widespread way because of the diversity of each specific target species or ecosystem. However, researchers have pinpointed two basic aspects of connectivity, which are the spatial arrangements of conserved land and their functionality (Crooks & Sanjayan, 2006, p. 2-3).

It is also not known whether these two key concepts of arrangement and functionality are being considered by green infrastructure visions in highly urbanized cities. Furthermore, it is not clear whether the planners in these cities have knowledge of the importance of these concepts when planning green infrastructure visions, which would indicate that they may be more inclined to incorporate them. Typically, “the design and planning professions are concerned with the spatial pattern or composition of particular forms or parts, and landscape architectural design and planning focus on the spatial composition of the landscape” (Collinge, 1998, p. 158). Also, zoning, the planner’s ubiquitous tool

proves to be ineffective when faced with private property even in trying to create conservation lands (Benedict & McMahon, 2006, pp. 169-170).

GREEN INFRASTRUCTURE

Principles

Historically, there have been several definitions of green infrastructure. They range from simple to complex. Many simply define green infrastructure as trees and natural space, the opposite of common development that is dubbed, "gray infrastructure" (Wolf, 2003, p. 1). However, most commonly, and for the purposes of this research, "green infrastructure is *an interconnected network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations"* and is, "the ecological framework needed for environmental social and economic sustainability—our nation's *natural life support system"* (Benedict & McMahon, 2002, p. 12). An almost identical definition provided by the President's Council on Sustainable Development under the Clinton administration states that green infrastructure is, "Our nation's natural life support system—an interconnected network of protected land and water that supports native species, maintains natural ecological processes, sustains air and water resources and contributes to the health and quality of life for America's communities and people" (Williamson, 2003, p. 4).

Green infrastructure is, therefore, based in the idea of considering nature parallel to human development and interests. This relates it to the idea of community-based conservation, which holds that if conservation and

development can be achieved together, it is mutually beneficial to both (Berkes, 2004, p. 621). Furthermore, "[t]he concept of Green Infrastructure has been introduced to upgrade urban green space systems as a coherent planning entity" and "it can be considered to comprise of all natural, semi-natural and artificial networks of multifunctional ecological systems within, around and between urban areas at all spatial scales" (Tzoulas, et al., 2007, p. 169). Additionally, it has been described by some as a good guide to smart urban development if properly and proactively planned because it takes into account both economic growth and nature conservation (Tzoulas, et al., 2007, p. 169).

In addition to the many ecosystem and ecological benefits that green infrastructure creates, it also benefits human expansion and economic progress, but not at the cost of human health. These approaches can assure benefits to health *and* the economic wellbeing of the communities that they exist within and around. By reconnecting people with nature, as previously mentioned, green infrastructure can assure the health of environments and individuals in a physical and psychological sense. As such, "healthy environments can contribute to improved socio-economic benefits for those communities as well" (Tzoulas, et al., 2007, p. 175).

However, green infrastructure visions in urban areas can lack promise because of a number of compounding land-use problems that include an endless number of stakeholders and players, politics and dilapidated land. Furthermore, though the benefits to them are numerous, as previously described, the public

could be too far removed from its natural world to make conservation of green space a priority. This is important to mend because, “Key to the notion of stewardship is sustainability—the idea that we should leave the things we care for at least as well as, if not better than, we found them” and historically, “management strategies and tactics have often focused on maximizing short-term yield and economic gain, rather than long-term sustainability” (Benedict & McMahon, 2006, p. 200). This should be mended because a main concept of green infrastructure management is calculating future needs and goals to assess needed actions“ (Benedict & McMahon, 2006, p. 201).

It is imperative that highly urbanized areas in particular are used to inspire strong political players to be more involved in conservation policy and approaches and to reach the large number of the population that dwells within our cities (Moskovits, Fialkowski, Mueller, Sullivan, Rogner, & McCance, 2004, p. 233). The first step to doing this is to reconnect cities with nature by creating green infrastructure visions that promote habitat connectivity through planning measures. Sustainability is a key concept in this because, “like green infrastructure, sustainability indicates a future orientation: doing things now in a way that future generations will not be deprived of resources or restoration, and/or enhancement of landscape resources and processes through conscious action (or inaction) so that the landscape will function in the future as well as or better than it does now (Benedict & McMahon, 2006, p. 201).

Theories

Green Infrastructure and Habitat Connectivity

Hubs

According to The Heritage Conservancy, hubs are the main areas for wildlife processes in a green infrastructure vision. These include reserves, managed native landscapes, working lands, parks and open space areas, and recycled lands (Williamson, 2003, p. 5). Essentially, these are the lands that have the most land area and can provide the most cover for species to propagate and carry out natural processes but the problem lies in the connection of hubs to each other. Most species cannot maintain a viable population when they are isolated. Thus the need for links. However, the hub size is directly correlated to its effectiveness in wildlife loss mitigation; the smaller the hub, the less effective the link. In fact, “in very small fragments, corridors may be completely ineffective in ameliorating the negative effects of habitat isolation” (Collinge, 1998, p. 166). Therefore, hubs and corridors rely on the design and optimal conditions of each other.

Links

According to The Heritage Conservancy, links are the connection to hubs that allow the migration and flow of wildlife processes. These include conservation corridors, greenbelts, and landscape linkages (Williamson, 2003, p. 5). But the most common and questionable linkages are conservation or wildlife corridors. They are defined by The Ninth Circuit Court Of Appeals as, “avenues along which wide-ranging animals can travel, plants can propagate, genetic

interchange can occur, populations can move in response to environmental changes and natural disasters, and threatened species can be replenished from other areas" (Yellowstone to Yukon Conservation Initiative, 1998, p. 113). From a scientific perspective, links are considered the connections that tie conservation network together, and in doing so, help maintain essential ecological functions and the health of ecosystems and wildlife (Benedict & McMahon, 2006, p. 13). They are touted as the conservation planning techniques that have the most potential to protect biodiversity. Even smaller, less suitable linkages provide immeasurable benefits to local species as they seek to move from hub to hub (Haddad & Tewksbury, 2005, pp. 250-256).

However, wildlife corridors are controversial and many have questioned their worth because of the lack of supportive empirical studies. Even so, they are being more widely used in urban planning due to the lack of other tools to mitigate habitat fragmentation (Tzoulas, et al., 2007, p. 170). Furthermore, the planning of these corridors is hard to determine because of the different needs of different organisms. One species' response to the corridor and the matrix itself could be very different from another (Tischendorf & Fahrig, 2000, p. 11).

Therefore, because of the effects of related variables such as corridor and hub sizes, location near riparian habitats and demographic constraints, choosing sites for green infrastructure components carefully is essential (Beier & Noss, 1998, p. 1249). These links also help to increase the amount of greenspace per person in cities and protect sensitive water bodies even in metropolitan areas

where waters are diverted underground (Forman, 2008, p. 177). However, what is most problematic to planners and conservationists is how to build a framework of high-quality sites for species management that lie in not only on public lands, but private property, as well.

Public and Private Land Green Infrastructure Components

Public

Public lands generally provide the most protection opportunities and needed management techniques for wildlife. However, traditionally public lands are not always the best examples of valuable habitat for species richness. Therefore, it is important that these areas are managed and selected in a more time efficient and logical way to assure biodiversity (Scott, et al., 1993, p. 35). This is an essential component to green infrastructure. Public lands are the most ideal hubs and links, in terms of protection, but the vast majority of species habitat lies on private lands. Wilcove et al. (1996) as restated by Merenlender et al. (1998) suggests that "some habitat for 95 percent of all federally threatened and endangered flora and fauna is on private land, and 262, or 19 percent of these species survive only on private parcels" (p. 66). Furthermore, "[b]iodiversity conservation efforts must include private land" (Merenlender, Huntsinger, Guthey, & Fairfax, 2004, p. 66).

The Heritage Conservancy lays a framework for choosing the best hubs for a green infrastructure vision in an urbanized area. These desirable sites include state game land, unique and endangered species habitat, cultivated

farmland landscape, prime agricultural soils, clean waters, wetlands and parks and schools. Likewise there is a linkage framework that includes rail line links, aquatic links and pedestrian links (Williamson, 2003, pp. 10-12). McMahon also describes green infrastructure as consisting of hubs that include regional parks and preserves, cultural, historic, and recreational sites, and trailheads. The linkages consist of landscape links, conservation corridors, greenbelts, trail corridors and utilitarian corridors (McMahon, 2000, p. 5). It is evident that many of the high-quality hubs and links from different concepts fall on private lands.

Private Lands

It is essential to systematic conservation planning and green infrastructure visions that wildlife refuges and parks are not the only form of nature conservation (Margules & Pressey, 2000, p. 243). Conservation easements are becoming a more popular form of private land conservation because they are voluntary and can be drafted with an individual's desires for their land in mind. They are defined as, "a legally binding agreement between the owner of the land subject to the easement and the holder of the easement that restricts the development and future use of the land to achieve certain conservation goals, such as the protection of wildlife habitat or the preservation of farmland or forestland" (McLaughlin, 2002, p. 453). There are several incentives provided but most often, these include income tax off-sets for a period of time along with other tax incentives.

However, conservation easements are not a viable substitute for nature reserves for a number of reasons, including biodiversity of the area and size and suitability of the land in question. There is also a "need for (1) clear guidelines for building and subdivision, scaled according to property context, purpose, and size; (2) research on the compatibility of private uses on conservation easement lands, particularly for easements that protect core target habitat; and (3) increased public understanding of the protection status ensured by conservation easements" (Rissman, et al., 2007, p. 717). Land trusts are the organizations most often in charge of conservation easements but have yet to exhibit a firm set of expectations for this private land conservation technique (Merenlender, Huntsinger, Guthey, & Fairfax, 2004, p. 73). Although the Land Trust Alliance now has a land trust accreditation process, it is a voluntary one (The Land Trust Alliance, 2011). Contributing to this issue is the complexity of environmental decision making (McLaughlin, 2002, p. 469).

Another governmental technique for conserving endangered and threatened species on private lands is habitat conservation plans. Habitat conservation planning as it relates to the Endangered Species Act (1973) has been both touted as a successful way to mitigate the negative effects of development on endangered and threatened species populations, and vilified as ineffective and lenient, detrimental to developers and inefficient in maintaining and increasing the species populations it was created to protect. However, this

is only applicable to owners of property with endangered or threatened species inhabiting or using it.

The issue of connectivity of conserved habitat is one of the main criticisms of habitat conservation plans (HCPs) and conservation easements, alike. However, progress has been made since the enactment of the “No Surprises” policy in terms of coverage area and the number of HCPs and their intricacy. But the ad hoc approach is still commonly used and makes the formulation of regional conservation areas extremely difficult. This piecemeal application also contributes, in some cases, to further species loss by diminishing land size so that conservation areas cannot support viable populations.

Therefore, a more systematic and regional approach is necessary to make the HCP a better tool in loss mitigation and perhaps, in many cases, a recovery tool. Systematic approaches to HCPs would help green infrastructure visions to promote biodiversity and connectivity of conservation habitats. Furthermore, regional HCPs can help to alleviate monetary and development constraints on private property owners and also make land conservation effective in mitigating biodiversity loss, while providing more opportunities for development (Thompson, 1997). This is being recognized internationally as well, with Chinese researchers who have noted that providing hubs and corridors can curtail habitat loss for the giant panda (Xu, Ouyang, Vina, Zheng, Liu, & Xiao, 2006). Multi species conservation plans like the successful San Diego scheme can be used by decision makers and conservation planners to calculate the appropriate amounts

of specific species needed for viability in green infrastructure vision design (Hilty, Lidicke, & Merenlender, 2006, p. 175).

Literature Gaps

Although little is known about their specific roles in highly urbanized green infrastructure initiatives, there is no doubt that planners play a key role in implementing and promoting them. Research indicates that the most important planner stimulus in green space planning was legislation, as opposed to biodiversity maintenance (Sandstrom, Angelstam, & Khakee, 2004, p. 43). Furthermore, in densely populated areas, there is little doubt that the loss of biodiversity in the ecosystems of urbanized regions can largely be attributed to local policy decisions and development, commercial and industrial pressures (Wang & Moskovits, 2001, p. 842). However, it is not known whether increasing planners' knowledge of key biodiversity concepts would improve the policy outcomes of green infrastructure plans. Furthermore, it is important to explore different levels of green infrastructure plans to ascertain how planners are involved in them.

GREEN INFRASTRUCTURE CASE STUDIES

Rural Conservation Networks

Yellowstone to Yukon

The Yellowstone to Yukon Conservation Initiative (Y2Y) covers areas of the western United States in addition to parts of western Canada and includes a coalition of over 170 individuals and organizations that are interested in the

conservation of the biodiversity in the Rocky Mountain and Mackenzie Mountain corridor. The overall mission of the initiative is to use the best available science to restore and preserve habitat connections along 1990 miles of mountains to provide safe linkages for wildlife habitat and migration using parks and federal lands as the core habitats with a new network of conservation cores and corridors to provide the connectivity (Yellowstone to Yukon Conservation Initiative, 1998, p. 1).

The creation of the habitat connectivity scheme is based around the needs of the grizzly bear. The grizzly bear is touted as a good indicator of how development and fragmentation are affecting a given region because it is considered an umbrella species. This means that existence encourages the survival of many other species in the same ecosystem (Yellowstone to Yukon Conservation Initiative, 1998, p. 113). In measuring the appropriate habitat for grizzly bears, there are three components used by the Y2Y Initiative. The first is habitat productivity, which measures food availability. The second is habitat effectiveness, which measures the land's level of human interaction. The overall habitat suitability is a measurement of a compilation of factors including the availability of food, breeding grounds, and distance from human interactions (Yellowstone to Yukon Conservation Initiative, 1998, p. 107).

A major goal of the Y2Y initiative is to devise an interrelated conservation plan for the two countries involved, Canada and the United States, with the major element being the design of linkages that include core areas, corridors and

transition zones in a mixture of landscapes with multiple uses (Yellowstone to Yukon Conservation Initiative, 1998, p. 7). Some of the most harmful uses that take place in this region of interest include forestry, oil and gas extraction, agriculture, and recreation and tourism, which cause fragmentation, micro and global climate change, wildlife displacement and changes in vegetation (Yellowstone to Yukon Conservation Initiative, 1998, pp. 57-59). There are several major threats to the biodiversity in the Y2Y ecoregion that can be applicable to other regions as well. These include the problems of road and human access to environmentally sensitive lands, the over-exploitation of certain natural resources like fish, invasive species introduction and expansion, pollution from industrial activities and the loss of connectivity of wildlife patches both on land and via the diversion and damming of waterbodies (Yellowstone to Yukon Conservation Initiative, 1998, p. 137).

Although this is not an example of a green infrastructure vision, it is a good example of habitat connectivity. Because the initiative stretches across county, state, and even national boundaries, it is an important example of how cooperation is an essential component in any habitat conservation scheme. Furthermore, even in this rural conservation design, it is evident that planning concepts like sprawl and transportation plans play a large role in generating problems, as well as the associated mitigation techniques to alleviate them. But are planning concepts also applicable or present in statewide green infrastructure visions?

Statewide Green Infrastructure Visions

The Maryland Greenways Program

Maryland's green infrastructure vision grew from the state's interest in a greenway network that provided trails as well as buffers to waterways such as the damaged Chesapeake Bay. Although the Maryland Greenways Program became popular, the recreational focus of the vision outweighed the protection of biodiversity. In an effort to alleviate this issue, the Maryland Department of Natural Resources with the Maryland Greenways Commission and the Baltimore County Department of Environmental Protection and Resource Management created a GIS modeling program to assess land cover, wetlands, sensitive species, roads, streams, terrestrial and aquatic conditions, floodplains, soils, and development pressures to develop a habitat connectivity scheme made up of high-quality hubs and links. As of May 2001 the state of Maryland created a new ecological network, GreenPrint, which focuses on the most valuable ecological lands, which included the 2 million acres pinpointed in the green infrastructure assessment. The Maryland assessment has since been an inspiration to places like the Delmarva Peninsula and consequently used by the states of Delaware and Virginia (Benedict & McMahon, 2006, pp. 16-19).

Planner's roles in the green infrastructure system are assumed but never fully elaborated. It is stated that in the Maryland assessment that "Socioeconomic and policy factors were taken into account to assess the economic values of the forestlands, and similar factors were used to evaluate their vulnerability to development," along with the ecological analysis (Benedict &

McMahon, 2006, p. 20). The same can be said of another statewide green infrastructure vision, the Florida Greenways Program.

The Florida Greenways Program

The Florida Greenway system was conceived by a group of scientists in the 1970's that included professors of the University of Florida. However, the state of Florida's green infrastructure plan began in 1991 with the coordination of several nonprofit and citizen's groups on the drafting of the Florida Greenways Program. The Florida Greenways Commission was formed in 1993 to evaluate the state of Florida's greenways and envisioned creating a green space and greenway system that spanned across the entire state (Benedict & McMahon, 2006, p. 50).

In 1994 the Vision was in the design process and sought to create two different types of networks. The first would be an Ecological Network made up of hubs and links that ran along the coast, rivers and watersheds. The second would be a Recreation/Cultural Network of trail corridors that connected parks, urban areas, landscapes and culturally and historically significant sites. Each area of conservation interest was put into a GIS model to determine the quality of the landscape as far as biodiversity. Finally, the vision moved forward in 1995 when it became a governmental program and received funding from the Florida legislature (Benedict & McMahon, 2006, pp. 51-52). The Department of Environmental Protection and the Department of Transportation "funded the greenways plan through the federal transportation program known as the

Intermodal Surface Transportation Efficiency Act (ISTEA), and DEP was the lead state agency" (Hoctor, Carr, & Zwick, 2000, p. 986).

The Florida Greenways Program is a good example of a rural to urban, large-scale green infrastructure vision. Furthermore, the designers were cognizant of the need to maintain biodiversity in the conservation lands that they chose for their infrastructure while also providing a structural system that allowed the citizens an avenue to interact with nature. However, there is still a lack of research on how planners were involved in the design and implementation procedure for this approach, as well as other highly urbanized green infrastructure plans.

Highly Urbanized Green Infrastructure Plans

The Chicago Wilderness Green Infrastructure Vision

It is not commonly known there is a high concentration of species-rich ecosystems and natural amenities in proximity to or part of the highly urbanized Chicago metro region. Some of these ecosystems include eastern tallgrass prairie, oak savanna, open oak woodland, and prairie wetland (Wang & Moskovits, 2001, p. 835). In order to protect these unique and imperiled ecosystems it is necessary to implement proper management procedures and connect the remaining high-quality habitat patches (Wang & Moskovits, 2001, p. 835). For these reasons, the Chicago Wilderness Initiative and their Green Infrastructure Vision were conceived and has now become the primary

conservation initiative in the Chicago area protecting over 81,000 ha of land for conservation (Wang & Moskovits, 2001, p. 835).

The Chicago Wilderness Green Infrastructure Vision began in April of 1996 and initially involved over 90 organizations. That number has expanded to over 170 organizations since its inception. The initial central goal of the Chicago Wilderness initiative was to restore the ecological integrity of some of its most species-rich and native lands, including prairies and open woodlands (Helford, 2000, p. 119). But that vision has been criticized, particularly for its approach to habitat restoration, which utilizes controversial tools that include removal of trees and brush, herbicide application, controlled burning, and removal of deer (Gobster, 1997, pp. 33-34).

However, the mission statement of the green infrastructure coalition, as defined by some of its most important players, is to provide

> "A thriving mosaic of natural areas, connected by greenways and wildlife corridors, embedded in the nation's third largest metropolis. In this vision, the region's human communities reclaim a cultural tradition of protecting and restoring the globally outstanding natural communities that enrich our lives" (Moskovits, Fialkowski, Mueller, Sullivan, Rogner, & McCance, 2004, p. 215).

Furthermore, Chicago Wilderness seeks to conserve, restore, and manage land for conservation purposes while also promoting compatibility with the populous human communities of the region (Wang & Moskovits, 2001, p. 836).

A major undertaking of the Chicago Wilderness coalition was the devising of a regional biodiversity recovery plan that brings together scientists, land

managers, as well as numerous public and private players to provide the tools to achieve the regional green infrastructure vision (Moskovits, Fialkowski, Mueller, Sullivan, Rogner, & McCance, 2004, p. 215). One major principle of green infrastructure is that it is a "critical public investment" and must combine public private partnerships and because Chicago Wilderness is "a grassroots collaboration of over 100 organizations representing all sectors with an interest in the region" it is successful in this aspect (Benedict & McMahon, 2002, p. 17). The plan has grown in notoriety and scope and will not only guide the conservation network establishment, but also facilitate better communication between economic and civic leaders and conservationists (Moskovits, Fialkowski, Mueller, Sullivan, Rogner, & McCance, 2004, p. 227).

In addition to the aforementioned regional biodiversity recovery plan, the Chicago Wilderness Green Infrastructure Vision works on a regional planning scale with the Chicago Area Transportation Authority which lead to the adoption of biodiversity conservation as a goal within its transportation plan. This has also led to a methodology that allows citizens and planners to do an environmental cost-benefit analysis of potential transportation development areas (Moskovits, Fialkowski, Mueller, Sullivan, Rogner, & McCance, 2004, p. 229).

Because of the relative success in its early stages of development, the Chicago green infrastructure vision is of particular interest to this research. With such a strong connection to planning, it is the goal of this research to further study the planners' roles in and knowledge of green infrastructure plans and

concepts. To augment this line of inquiry, the research will also assess whether the conserved spaces already defined by the vision are primarily for the benefit of the local species or recreational uses.

Given the lack of research on these topics, it is the goal of this thesis to answer the following research question:

> What roles do planners play in creating green infrastructure visions in regions with a highly urbanized city that has a population of over one million people, and if they play a role, do they contribute to making it a viable green infrastructure approach?

RESEARCH GOALS

Although it is essential to maintain biodiversity and a connection to natural areas of the world, development is beginning to sever our ties to nature. Furthermore, species connections to their habitats are being destroyed at a rapid and concerning pace, particularly in highly urbanized areas. Green infrastructure visions seek to alleviate some of the ill effects of development on nature, while also considering the need for human economic progress.

However, not much is known about how large cities with over one million residents in their cores and hinterlands can effectively implement green infrastructure visions. Furthermore, although planners play a key role in implementing and realizing these approaches, little is known about how their role impedes or promotes them. International studies have shown that planners feel

that policy decision outweigh the importance of biodiversity, but is this always the case? Would planners' understanding of biodiversity help to improve the chances of a green infrastructure or other habitat connectivity approach in its ability to provide habitat for local wildlife?

Keeping these questions in mind, it is the intended purpose of this research to explore the concepts of biodiversity, habitat connectivity and green infrastructure approaches and how planners in cities are implementing them in highly urbanized areas. It also seeks to discover if the green infrastructure plans that are being implemented in these areas are more biocentric or anthropocentric, functional or structural.

METHODOLOGY

Case Study

In addition to background research, this thesis involved an in-depth case study of the Chicago Wilderness Green Infrastructure Vision due to its large number of participating partnerships and relatively large scale in a highly urbanized city and hinterland. Aspects of this case study include a survey distributed to participating partners. The survey population included employees of interest who work for the identified partners of the Chicago Wilderness Green Infrastructure Vision, as well as planners from the Chicagoland area including Cook, Lake, DuPage, McHenry, Kane and Will counties.

A case study was chosen because Chicago Wilderness' Green Infrastructure Vision is a "contemporary phenomenon" that can be related to

other conservation approaches (Yin, 2009, p. 18). Chicago is considered "special" for its planning and green space conservation. These include the formulation of the City Beautiful Movement, the famous 1909 Plan of Chicago, its group of social scientists that related ecology to urban dynamics, greenway plans and the "green" Chicago movement that includes the push for increasing the number of designated natural areas (Forman, 2008, p. 12). Furthermore, this "case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence with data needing to converge in a triangulating fashion" (Yin, 2009, p. 18). Taking this into consideration, multiple research techniques were implemented in order to show how planners are involved in these visions using one specific case, but creating a methodology that can be applicable to other large-scale green infrastructure plans of this nature.

Therefore, this will be a single case study because it not only represents a critical example of a green infrastructure vision, but it is also a unique case because of its successful coalition of public and private entities and history of innovation in the planning and conservation fields (Yin, 2009, pp. 46-47). Additionally, because of the scope of the project, only one region that meets the qualities enumerated in the research question could be studied in the timeframe for the research. However, as previously mentioned, this project seeks to create a research methodology that can be applicable to similar areas of the United

States including Los Angeles, San Francisco, New York City and Washington D.C.

Highly urbanized cities are defined for the purposes of this research by the U.S. Census Bureau as, “comprising all territory, population, and housing units in urbanized areas and in places of 2,500 or more persons outside urbanized areas” (US Census Bureau, 1995). Because of the high concentration of people in Chicagoland, all five of the counties surrounding Cook County, where the city of Chicago is located, meet these criteria. Therefore, the case study includes the counties of Cook, Dupage, Kane, Lake, McHenry, and Will.

It also avoids ecological fallacy by examining planners’ involvement in the green infrastructure vision. This was done through the aforementioned survey as well as a review of plans in the Chicago region. In reviewing the characteristics of green infrastructure in place, there will be less likelihood of falsely attributing any of the positive or negative outcomes to the wrong variables (Yin, 2009). There was also a spatial analysis to provide ground-truth on the viability of the green infrastructure visions from a functional and structural perspective. In this way, survey results, plan goals and actual conservation land were compared.

Review of Existing Plans

To understand whether components of green infrastructure have been incorporated into planning documents, and as such, planners’ tasks, a number of plans in the Chicagoland area were reviewed. They were then compared to basic green infrastructure principles and theories, as well as, the original Chicago

Wilderness green infrastructure vision. These plans included the Chicago Metropolitan Area's regional plan, as well as smaller suburbs in the six county coverage area. This provides opportunity to verify the survey results with information on how green infrastructure implementation and formulation is taking place in the region and the study area's counties and municipalities.

Surveys

After establishing information and a list of the aforementioned contacts of interest, a survey was distributed and sent to the involved planners and conservation biologists, in addition to others that might be involved in the Vision. The goal was to gain information on whether and to what extent planners have contributed to the vision from their own perspective and what they have contributed to its viability from a scientific viewpoint.

The survey included opportunities for the participants to explain planners' effect on implementing green infrastructure techniques from their personal experience (their own and examples they have witnessed). For viability purposes, a subset of questions asking planners knowledge of biodiversity concepts as they relate to conservation approaches, such as the functionality and structural purposes of conserved land, was also included. Within this, the idea of ecological footprints was presented. Ecological footprints are defined as, "the effect or 'load' imposed on the biosphere by a population or person" (Forman, 2008, p. 64). These questions focused on the concept that there is an

inherent link between humans and their natural systems independent of changes in economics, trade and technology (Forman, 2008, p. 64).

One of the overarching goals of the survey was to explore the intersection of planning and habitat ecology. This involved ascertaining the planners' knowledge of scientific and conservation principles, and then evaluating their opinions on whether/what concepts will help them in their field. Additionally, this research identified ideas they do not understand and their levels of collaboration with the Vision, specifically.

The population of desired survey respondents included public and private sector planners, ecologists and conservation biologists from various companies, firms and levels of government that are partners with Chicago Wilderness. This was done to explore as many different perspectives as possible in determining how the Vision was designed and implemented, utilizing both planning and biodiversity principles. However, the opportunity was open for people of other career paths with knowledge of the Vision. The total population identified was 304 professionals, and the survey was customized based on profession. Therefore, because of the large population and short research time period, an Internet questionnaire was issued to the population via email. The study was open for response for three weeks with a weekly email reminder.

An Internet survey was chosen because it is not only a more efficient and effective research approach, but it also reduces costs, has a short turnaround time, and makes reaching respondents easier. Furthermore, it can reduce

transcription and coding errors, increase motivation to participate, and be an efficient means of reaching a large population. It also boasts much higher response rates than other means of surveys in some study populations. (Zhang, 1999, pp. 57-58).

The survey avoided issues of respondent access because the subjects are all professionals in a highly urbanized area and it was likely that they had access to the Internet and familiarity and comfort with its use. Also, because the population had to meet such specific criteria, there is little chance that random respondents gained access to the survey. To validate survey results that suggested that the Vision was designed with the intent to preserve biodiversity, a gap analysis was completed for verification.

Gap Analysis

Richard T. T. Forman states that, "[t]he ability of an animal moving along a natural-vegetation corridor to cross a gap or break in the corridor especially improves as gap length relative to the spatial scale of species movement shortens, and with more suitable conditions in and around the gap" (Forman, 2008, p. 231). Regional connectivity is also essential. Where gaps rather than connections between habitat patches exist, there is a lack of regional connectivity for the migration and natural movement of species and it is essential to restore corridors that provide connections to conserved patches, especially in urbanized or growing areas (Forman, 2008, p. 147).

Given the importance of maintaining connectivity to propagation of biodiversity, the survey results will be verified using a spatial Gap Analysis. By identifying Chicago's most suitable habitats and juxtaposing them with identified lands of interest in the Vision, it was determined whether the Vision promoted biodiversity over human recreation (Scott, et al., 1993, p. 123). Furthermore, the Gap Analysis evaluated the level of actual protection for wildlife species using various biological distribution factors in tangent with information on the areas highlighted in the current Chicago Wilderness Green Infrastructure Vision map (Davis, Stine, Stoms, Borchert, & Hollander, 1995, p. 40).

For the purposes of this research, the Chicago urban region needs definition. According to Forman, "often a single large city is the major hub, though a number of linked cities may characterize a region" (Forman, 2008, p. 11). Transportation networks that connect the city to surrounding areas can also define a region (Forman, 2008, p. 11). This is the basic principle on which the coverage area for the gap analysis was determined. The hub is Chicago in Cook County, while there are several important municipalities in the surrounding five counties of Kane, Lake, DuPage, Will and McHenry, the same areas identified for the case study. These are also the areas that are connected to the city through transportation modes including the Metra commuter rail system. Therefore, the six counties of Cook, DuPage, Kane, Lake, McHenry, and Will were considered the urban region of Chicago for the purposes of this research.

The idea of a bioregion is also applicable to Chicago because of its aforementioned cultural and ecological ties to both the planning and conservation fields (Forman, 2008, p. 14). Furthermore, the concept of the ecoregion is important to consider. This is because "conservation efforts are increasingly focused at the landscape or ecoregion level rather than localized sites" (Edwards, Moisen, & Cutler, 1998, p. 74). Forman states that this idea, "specifically highlights biological distributions over a large area" and is" typically characterized and delineated by climate, geology, topography, and associations of plants and animals" however, "normally urban regions are much smaller than an ecoregion, though the location of an urban region may have considerable impact on the processes across an ecoregion" (Forman, 2008, p. 14).

Therefore, the counties that constitute the Chicago urban region can also be considered a bioregion, and are integral to ecoregion functionality. The natural features of this particular ecoregion consist of large systems of wetlands and freshwater lakes and rivers, as well as prairies and woodlands. These natural areas, established conservation areas and agricultural lands within the six county urban region are the characteristics mapped in the gap analysis.

Watersheds also serve as important natural boundaries that are distinguished from political lines (e.g., the Chesapeake Bay Agreement, which brought together political leaders from Maryland, Pennsylvania, Virginia and the District of Columbia in an effort to preserve their shared water systems) (Benedict & McMahon, 2006, p. 206). Green infrastructure is critical to

watershed management in many instances. Researchers state that, "management of the hubs of a green infrastructure network, comprised of forest, wetlands, and native grasslands, can contribute significantly to a watershed's water and habitat quality" (Benedict & McMahon, 2006, p. 208). Conversely, watershed management is essential to the success of green infrastructure (Benedict & McMahon, 2006, p. 208). Therefore, the Chicago urban region's watersheds and, consequently, catchment areas will also be examined to ascertain their inclusion in the green infrastructure vision and, by extension, their protection within the political boundaries of the area.

The Gap Analysis, using ArcGIS software, delineated the areas that were most likely to foster biodiversity. In research done in Costa Rica, protected areas were assessed for their suitability to maintain biodiversity (Powell, Barborak, & Rodriguez S., 2000, p. 35). This was achieved for the Chicago Green Infrastructure Vision using spatial data from the Illinois Data Clearinghouse, the USGS National Gap Analysis Program, Chicago Wilderness, the Illinois Department of Natural Resources, the Illinois Army Corps of Engineers and the Chicago Fish and Wildlife Service. The combination of the gap analysis, in concert with the review of area comprehensive plans and the survey, resulted in several important findings on how planners are implementing green infrastructure in the study area.

FINDINGS

Comprehensive Plan Review

After reviewing the comprehensive plans of the Chicagoland area it is apparent that green infrastructure concepts are present in many of the plans for both cities and counties. The Chicago Wilderness Green Infrastructure Vision is most notably mentioned in the Chicago Metropolitan Agency for Planning's GO TO 2040 plan. This is the first regional comprehensive plan for the Chicagoland region since the famous Daniel Burnham plan in 1909 and is often referred to by municipal and regional planning organizations in the area (Chicago Metropolitan Agency for Planning, 2011).

The Lake County Regional Framework Plan

Although the Chicago Wilderness Green Infrastructure Vision is not specifically mentioned in the current Lake County Regional Framework Plan, basic concepts of the system are present. First, the plan mentions the importance of having a connected network of open space, with corridors like greenways. It also briefly discusses private conservation approaches like conservation easements and not-for-profit organizations. Additionally it acknowledges that there should be a priority system of open space conservation based on the suitability of the land for maintenance of biodiversity, rather than for recreational parks (The Lake County Regional Planning Commission, 2007, pp. Sc. 4 1-36).

The McHenry County 2030 Comprehensive Plan

The McHenry County 2030 Comprehensive Plan objectives include the concepts of linking open areas and waterways, fostering wildlife migration, utilizing corridors, and making recreational connections to open space (McHenry County Regional Planning Commission, 2010, p. 43). Furthermore, there is a section detailing the importance of green infrastructure to the county. The plan also states that "the concept of green infrastructure incorporates resources and facilities at a range of scales and serves varied functions in the lives of residents" (McHenry County Regional Planning Commission, 2010, p. 44).

The plan discusses the importance of parks and other recreational areas in realizing green infrastructure. Additionally, from a regional perspective, it states that greenways, parks and other areas of conserved open space provide important interaction between people and wildlife. Furthermore it is stated that, "any plan for the County's future must incorporate an inventory of its valuable open space assets, greenways, and natural resources in order to inform and facilitate wise land use decisions that protect environmentally sensitive areas and provide quality opportunities to experience healthy, vibrant natural settings for generations to come" (McHenry County Regional Planning Commission, 2010, p. 44).

Habitat fragmentation's negative impacts, the importance of biodiversity, the need for habitat connections for the continuation of endangered and listed species, the need for naturally rich areas for the quality of life of residents and the concepts of public and private conservation lands are discussed within the

environmental element of the plan. There is also discussion of municipal contributions to the green infrastructure process (McHenry County Regional Planning Commission, 2010, pp. 49-56). It states that “many park districts, such as the Cary Park District, have long realized the importance of greenways and have included them in their plans as linkages between parks” and that “several municipalities, such as the City of Crystal Lake are also including greenways in their future plans to be used both as wildlife corridors and as connecting links between McHenry County Conservation Districts” (McHenry County Regional Planning Commission, 2010, p. 56). Therefore, although the plan does not specifically mention the Vision, this is an example of how green infrastructure concepts are being implemented on the county level.

The Sugar Grove, Illinois Comprehensive Plan

The Sugar Grove, Illinois Comprehensive Plan has a Parks, Open Space and Greenway initiative. This program seeks to preserve naturally rich areas and provide recreational opportunities for its residents to connect to wildlife. Specifically, “the plan strives to set aside areas with special environmental and ecological value for protection from development” in order to create, “habitat for wildlife, and corridors for the natural flow of stormwater and the movement of wildlife” (URS-TPAP, 1999, p. 50). This is a key concept that contributes to green infrastructure visions. Through greenway corridors that include wetlands, flood plains, areas of ecological significance and neighborhood connection the plan describes the necessity to create a framework for an open space network

that connects residents to nature in addition to protecting it (URS-TPAP, 1999, p. 50). This is comparable to the Chicago Wilderness Green Infrastructure Vision's goal of creating viable habitat corridors being implemented in local level planning.

Chicago's 2040 Comprehensive Plan

The most notable plan of the area is the Chicago Metropolitan Region's future comprehensive plan that covers Cook, DuPage, Kane, Lake, McHenry, and Will counties. In reviewing this plan, there were many connections and even direct references to the Chicago Wilderness Green Infrastructure Vision. This provides significant evidence that the system is being implemented in the area's planning goals.

In the environmental section, the importance of maintaining biodiversity is often mentioned. The plan warns of long-term consequences that will arise with the loss of species and climate change. The plan also delineates the positive outcomes of protecting Chicagoland's natural environment, including several economic and lifestyle benefits (Chicago Metropolitan Agency for Planning, 2010, p. 45).

The plan discusses the larger regional goals of habitat conservation. It states that, "the Regional Vision for GO TO 2040 describes a future environment in which 'open space [is] preserved and enhanced,' the region consumes 'less energy and fewer natural resources,' treats 'water…as a critical natural resource,' preserves 'the overall ecological health and diversity of the region,' and improves its residents' health through 'the availability of open space, transportation and

recreation options, healthy food, clean water, and clean air" (Chicago Metropolitan Agency for Planning, 2010, p. 45). The agency proposes to accomplish these initiatives through the improvement of the parks and open space networks to provide recreational opportunities for the human population, while also protecting natural resources that are important to the functioning of the ecosystem. The actions needed to accomplish this objective are stated as follows: an increase in the resources for the development of a network of open space, shaping communities in a more environmentally conscious way, being cognizant of water and energy uses, promoting green jobs, and utilizing local food systems. Therefore, major goals of the green infrastructure vision are fully incorporated into the future goals of the region as a whole (Chicago Metropolitan Agency for Planning, 2010, p. 45).

The plan's drafters also acknowledge the deficit of valuable open space protection to mitigate the sprawling outward growth at the region's edges. Within this, the concept of habitat fragmentation is addressed in terms of recreation, biodiversity conservation, and the overall health of the ecosystem. Habitat connectivity is also identified as an important tool for the region to incorporate with the plan, stating that "ecosystem health can be achieved by preserving large natural areas with connections between them" because "ecosystems do not function well as small, isolated islands of open space" (Chicago Metropolitan Agency for Planning, 2010, p. 45).

The plan goes on to mention green infrastructure specifically and the need to expand the current open space network. It recommends three initiatives to achieve a better green infrastructure. The first is to increase the number of parks in the region, attaining the minimum standard of park access even with the dense development already in place. The second is to set aside the land that is most vital to biodiversity. Over the next 30 years this should be approximately 150,000 acres of ecologically important lands, including those along waterways, around existing conservation and preservation lands, and large hubs of open space. Finally, the network should attempt to create corridors between parks and preserves, using such greenways that should be doubled in the next 30 years (Chicago Metropolitan Agency for Planning, 2010, p. 116).

Additionally, the plan recommends that municipalities, the six counties, and the state of Illinois work together to develop cohesive policies that promote and protect the region's green infrastructure. Local governments should highlight open space networks during their comprehensive planning processes in addition to changing zoning regulations. Furthermore, the promotion of green building, new urbanism and mixed-use communities should be used to aid in the development and continuation of those networks regionally. Also, regional and statewide policy decisions that compromise the vision should be avoided (Chicago Metropolitan Agency for Planning, 2010, p. 116).

The Chicago Wilderness Green Infrastructure Vision is specifically identified by the plan. It states that, "engagement with stakeholders in the

conservation community indicated that the Chicago Wilderness Green Infrastructure Vision should be the primary conservation basis of the GO TO 2040 Plan" and that the Vision correctly identifies, "large preserves or 'hubs' linked with a set of open space corridors that generally follow rivers and streams" (Chicago Metropolitan Agency for Planning, 2010, p. 127). The authors also state that subregional planning efforts "recognize the importance of preserving land in a connected network and largely follow the pattern in the GIV" (Chicago Metropolitan Agency for Planning, 2010, p. 129). In addition to planning efforts the importance of finding funding for preservation activities should be discussed in many local plans around the region to ensure that corridors can be created and maintained. A cited example, the Grand Victoria Foundation policy mandates that all of its land acquisition projects "further the goals of the Illinois Wildlife Action Plan and contribute to a connected system of natural lands" which is "criteria well aligned with the GIV" (Chicago Metropolitan Agency for Planning, 2010, p. 129). It is important to look for how green infrastructure is present in area comprehensive plans to verify survey results and examine how planners have accepted the Vision.

Green Infrastructure Presence in Area Comprehensive Plans

As previously mentioned in the plan reviews, there were specific references to green infrastructure in general and the Chicago Wilderness Green Infrastructure specifically. The Lake County Regional Framework Plan mentioned green infrastructure once throughout the plan, but it referenced the

use of swales and natural depressions for stormwater management. Although the term was used, it did not apply concepts like habitat connectivity and preservation of open space.

The McHenry County 2030 Comprehensive Plan also referred to green infrastructure but not the Chicago Wilderness Green Infrastructure Vision specifically. However, the plan was well aligned with the larger Vision's goals of habitat connectivity and conservation of ecologically important lands. It is clear that the Vision was reviewed when drafting this comprehensive plan.

Finally, the only plan reviewed that specifically mentioned the Chicago Wilderness Green Infrastructure Vision was the GO TO 2040 Regional Plan for Chicagoland. In this plan green infrastructure goals were defined and included increasing the number of parks and preserves, preserving lands that are vital to maintaining biodiversity, and increasing the number of connections to these lands through tools such as greenways. It also provides a framework for implementation of the Vision on local levels by instructing planners to designate conservation lands using the watershed approach and creating habitat networks instead of hubs.

This information suggests that green infrastructure itself is not prevalent in the local and county comprehensive plans, but is included in regional and some county planning efforts. However, as mentioned in the comprehensive plan review, there are examples of concepts important to the vision in many local, county and regional plans. From this information we can assume that local

stakeholders should be more engaged with the Vision, even if they are already applying its concepts in their environmental and infrastructure goals.

Plan Assessment

From the review of the comprehensive plans it is apparent that green infrastructure concepts are being implemented on the regional, county and local levels of planning in the Chicagoland area. While the majority of the plans reviewed did not mention green infrastructure or the Chicago Wilderness Green Infrastructure Vision directly, they included concepts that promote its implementation, such as greenways and open space conservation. The Regional GO TO 2040 Chicago comprehensive plan describes how the Vision should be incorporated into other levels of planning and its contingency on planners. This is further discussed in the survey results described in the following section.

Survey

Content and Administration

The objective of this survey was to determine whether the Chicago Wilderness Green Infrastructure Vision included the participation of professionals in the planning field and, if so, if to what extent their participation has contributed to its implementation and viability. The survey consisted of four paths asking respondents of different career fields about whether planners have contributed to the Vision, how they have or have not helped it, and the extent of their roles as they relate to the green infrastructure concepts previously discussed.

The survey was implemented using a subscription from Survey Monkey, an online survey distribution tool, and responses were collected using this service as well. Participants were contacted and given the survey link and a glossary of terms via email and were given three weeks to respond with weekly reminder emails. The contact email, glossary of terms and the full survey paths can be found in the Appendix and the survey logic is delineated in Figure 1: Survey Flow Chart.

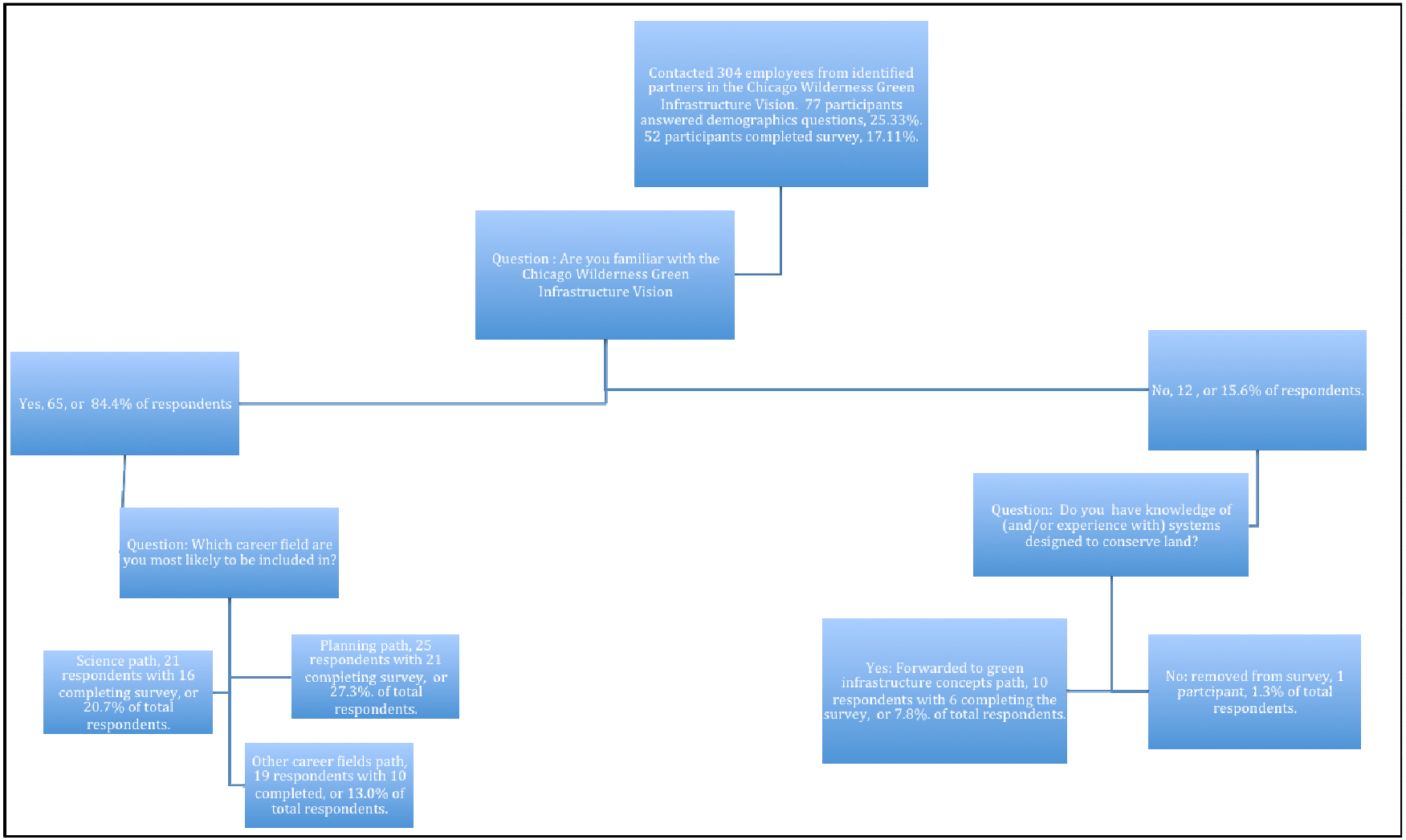

Figure 1: Survey Flow Chart

This method of survey distribution was chosen because of time and monetary constraints. Electronic surveys generally "have higher initial fixed costs but limited marginal costs" (Kroth, et al., 2009, p. 247). They have been identified in the past decade as one of the easiest and most cost-efficient means of data collection (Parsons, 2007, p. 13). Literature also suggests "noncoverage (lack of access to the Internet) appears to be of greater concern than nonresponse (unwillingness to participate given access) for representation in internet surveys" (Couper, Kapteyn, Schonlau, & Winter, 2007, p. 131). It can be assumed that participants of interest, employees in a highly urbanized area have access to the Internet.

Survey Population and Response Rate

The survey was distributed to city, county, and regional planners in the Chicago metropolitan area. Other potential participants were people of all career fields that were employed by organizations that are identified as being players in the Chicago Wilderness Green Infrastructure Vision by the Chicago Wilderness website. These included conservation biologists, ecologists, planners, land managers, and others. Though the identified population was 304 members of the green infrastructure vision process, participants were told to forward the survey to any party that might be more qualified to answer survey questions.

The area of interest of this project is the Chicago Metropolitan Area, which is comprised of the aforementioned six county study area. The Green Infrastructure Vision seeks to expand into neighboring Wisconsin and Indiana in

the future, which resulted in a small number of participants being from these areas. Therefore, some respondents were from neighboring states and outside of the six-county study area.

Of the 304 potential participants identified in the study population, 77 began responding to the survey. However, only 52 participated to completion. Therefore, although 25.33 percent of the targeted population answered the survey, only 17.11 percent completed it. The demographics analysis included information from the 77 original participants, but content analysis was limited to the 52 respondents that completed the survey in its entirety.

Survey Findings

When asked specific job titles, many respondents answered that they were coordinators or managers, planners, program directors or assistant directors. Additionally, 75 of 77 respondents answered which state they were employed but only 74 of 77 answered the specific municipality. Of 75 participants that answered their state of employment, 72 worked in Illinois, two were employed in Indiana, and 1 worked in Wisconsin. A large percentage of the respondents that answered their specific municipality of employment, 31.1 percent, identified their place of employment as Chicago proper, 64.9 percent specified a smaller Illinois municipality, and three were from surrounding states as shown in Table 1: Respondent Locations of Employment.

Table 1: Respondent Locations of Employment

Participant Locations	Number of Respondents
Chicago	23
Smaller Illinois Municipalities	48
Indiana	2
Wisconsin	1

The participants were also fairly experienced in their current career fields. They were asked how long they had been employed in their current position. There were a total of 75 respondents that answered this question. Of those, 46, or 61.3 percent had over five years of experience at their current positions as shown in Table 2: Participant's Years of Experience at Current Position.

Table 2: Participant's Years of Experience at Current Position

Years at Current Position	Number of Respondents
0-5 years	29
6-10 years	20
11-15 years	10
16-20 years	6
20+ years	10

Although the Chicago Wilderness non-profit identifies both public and private green infrastructure partnerships, the vast majority of respondents were from the public sector. This is denoted in Figure 2: Respondents' Employment Type below. All 77 participants responded to this inquiry. Of those, 60, or 77.9 percent were from the public sector and 17, or 22.1 percent identified as being employed in the private sector.

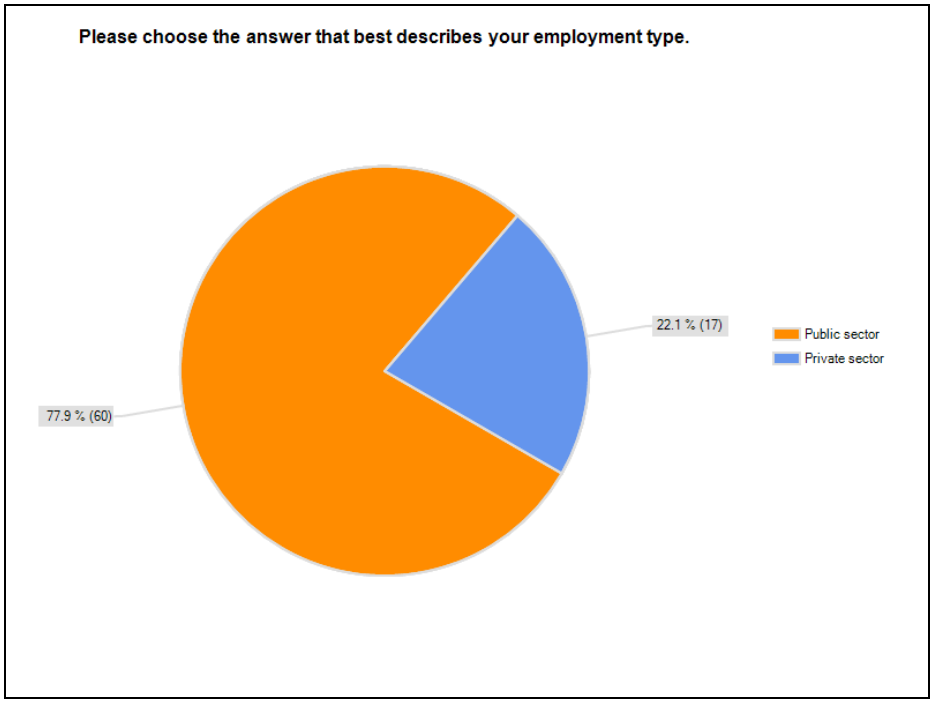

Figure 2: Respondents' Employment Type

All participants were asked if they were familiar with the Chicago Wilderness Green Infrastructure Vision. As expected, the majority of those that answered were familiar with the vision. Those that were familiar with the vision totaled 88.4 percent, or 65 participants, while those not familiar with the vision totaled 15.6 percent, or 12 participants. This breakdown is shown in Figure 3: Respondents' Familiarity with the Vision.

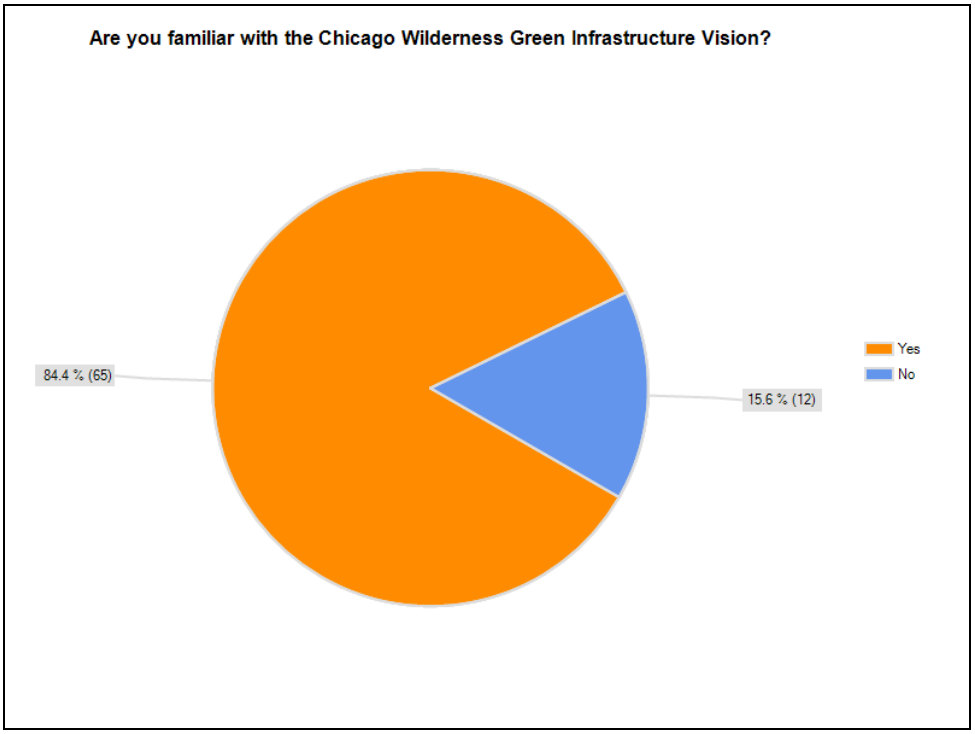

Figure 3: Respondents' Familiarity with the Vision

Respondents were also asked to identify the career field into which their current position was most likely to be categorized. Participants were distributed somewhat equally between the science and planning fields with 38.5 percent or 25 respondents being from the planning field and 32.3 percent or 21 respondents being from the science field. Another 29.2 percent or 19 respondents answered "other" to this question as shown in Figure 4: Respondents' Career Fields. Survey takers that fell into other career paths were prompted to describe which career field their current position would fall into. These fields included administration, communication, conservation, management, and academia.

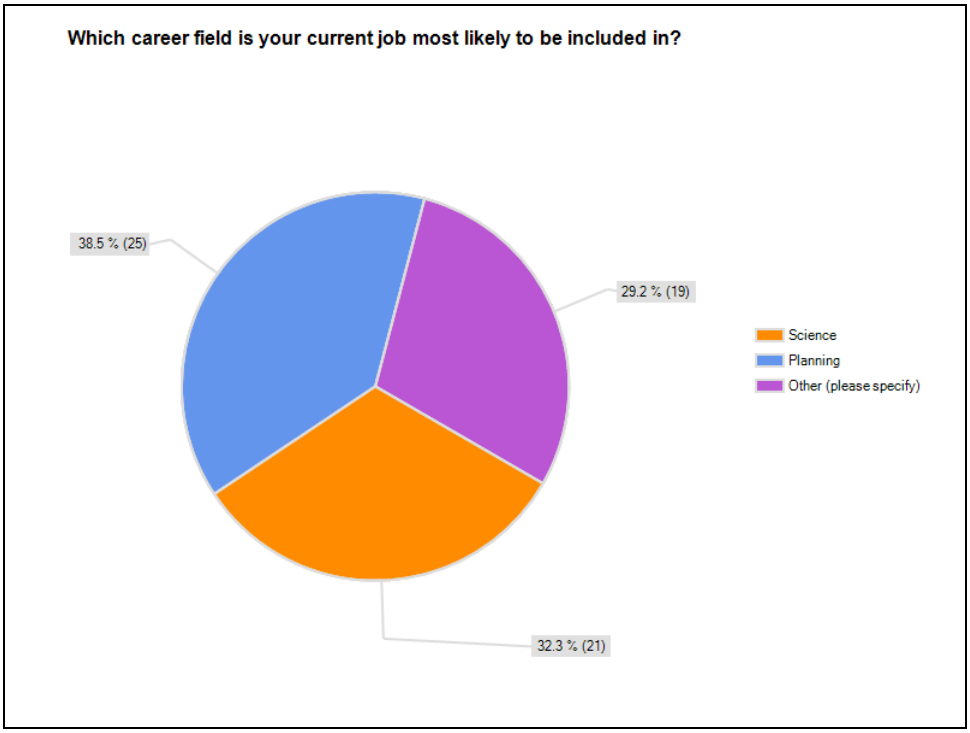

Figure 4: Respondents' Career Fields

The Science Path

Those respondents that answered "Science" to the aforementioned career field question were directed down a path of queries used to discover the extent of planners' roles in the green infrastructure implementation process from a biological and ecological standpoint. The first set of questions was asked using a Likert Scale. Of the 15 respondents of this question, a majority, 53.3 percent or 8 participants, identified themselves as being involved with the Chicago Wilderness Green Infrastructure Vision, two chose N/A and 5 disagreed that they were involved to varying degrees. The same number, 53.3 percent or eight participants, expressed familiarity with planners' roles in the Vision. In the open-ended follow up question about the extent of planners' roles, there was a wide spectrum of responses including ordinance formulation and open space

designation. This suggests that the majority of those directed down this path were involved with the Vision, and were familiar with planners' roles in it.

The science path was then given another Likert Scale question that asked them to rank statements about planners involved in the Green Infrastructure Vision, and the planning field in general. These statements included the green infrastructure concepts of biodiversity, ecological footprints, habitat fragmentation and corridors, private land conservation tactics and sustainability. Additionally, the science path was asked to rank statements about planners' roles in perpetuating the Vision and its presence in city and county comprehensive plans.

There were identifiable trends in the data. When asked to rank whether the planners involved in the Chicago Green Infrastructure Vision are knowledgeable about the importance of maintaining biodiversity, there were no responses that suggested that they were not. Only two chose N/A or Neutral, while 14 respondents agreed that they were with eight, or 50 percent strongly agreeing. However, when asked to rank their agreement with the statement as it relates to planners in general, only one participant strongly agreed. This suggests that there are planners involved in the Vision that are knowledgeable of the concepts associated with biodiversity, but that scientists believe that uninvolved planners are not as familiar with these ideas.

When asked to rank statements about whether city comprehensive plans reflect the Vision, 12 out of 16 respondents, or 75 percent expressed that they did not, with 25 percent strongly disagreeing, 25 percent moderately disagreeing,

and 25 percent mildly disagreeing with the statement. Similarly, 68.8 percent of respondents expressed that county comprehensive plans do not reflect the Vision. When ranking this statement, 18.8 percent strongly disagreed, 25 percent moderately disagreed, and 25 percent mildly disagreed. Despite this, 75 percent or 12 out of 16 respondents in this path agreed with the statement that planners have an integral role in perpetuating the Vision with one strongly agreeing, six moderately agreeing and five mildly agreeing.

When asked how comprehensive plans reflect the Vision, participants were prompted to check all of the options that applied. When asked how the Vision was reflected in city comprehensive plans, 42.8 percent, or 7 respondents, identified simply the drafting of area plans that include the Vision's goals as the most obvious contribution. Although 31.3 percent or 5 respondents chose both promotion of the vision to stakeholder groups and promotion of the use of private land conservation approaches, such as conservation easements, as ways in which the plans reflect the Vision.

When asked how county comprehensive plans reflect the Vision, 37.5 percent, or six respondents, identified zoning and the designation of contiguous patches of open space as the most obvious contributions. However, the choices were somewhat evenly distributed, with no one category soliciting more than six or less than four responses. The results of this question are shown in Figure 5: Scientists' Opinions About County Comprehensive Plans. This suggests that while scientists felt that planners evenly promoted different aspects of the Vision

within county comprehensive plans, the majority of the path thought that county comprehensive plans failed to reflect the Vision.

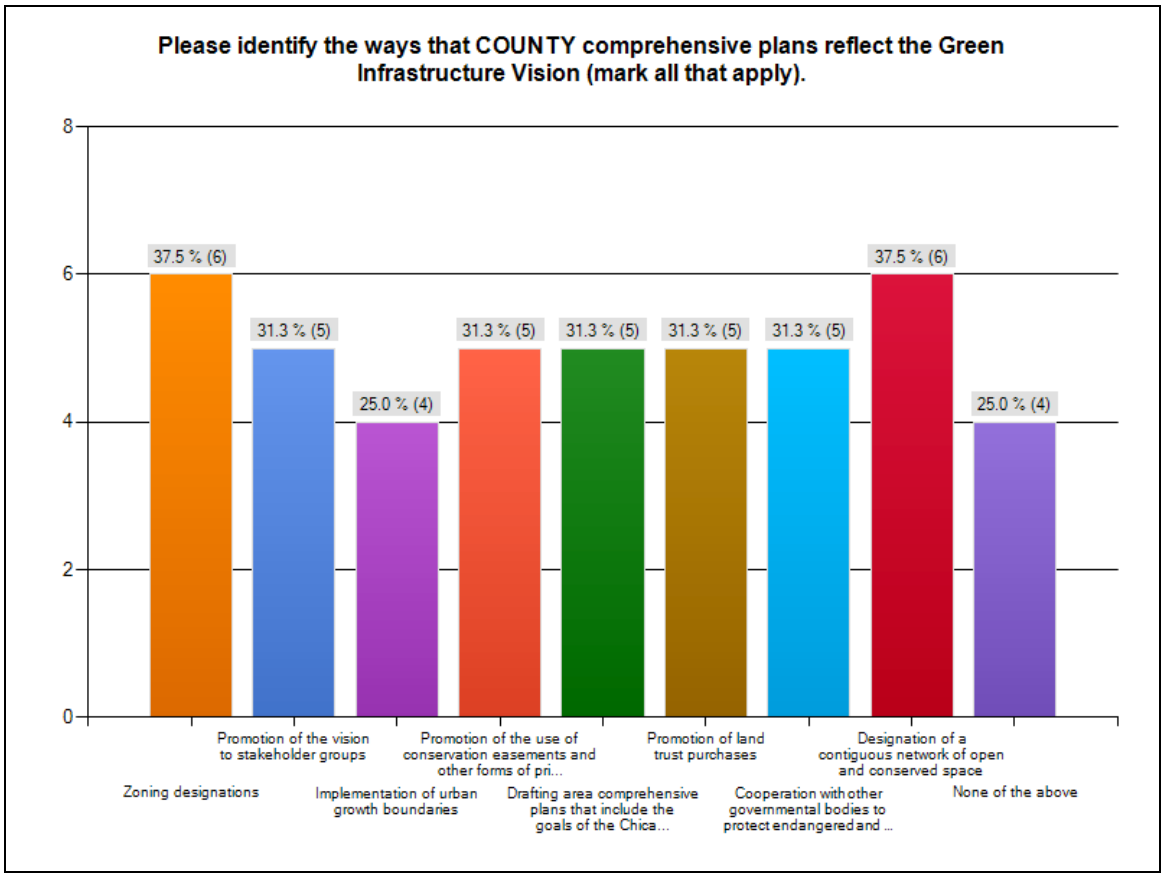

Figure 5: Scientists' Opinions About County Comprehensive Plans

There were stronger opinions when participants were asked how planners have aided in the Green Infrastructure implementation process. Half of all respondents chose promotion of the vision to stakeholder groups, promotion of private land conservation approaches, drafting area comprehensive plans that include the goals of the vision, and designation of contiguous patches of open space as ways that planners promote the implementation of the vision. The

results are shown in Figure 6: Scientists' Opinions About How Planners Have Aided the Vision.

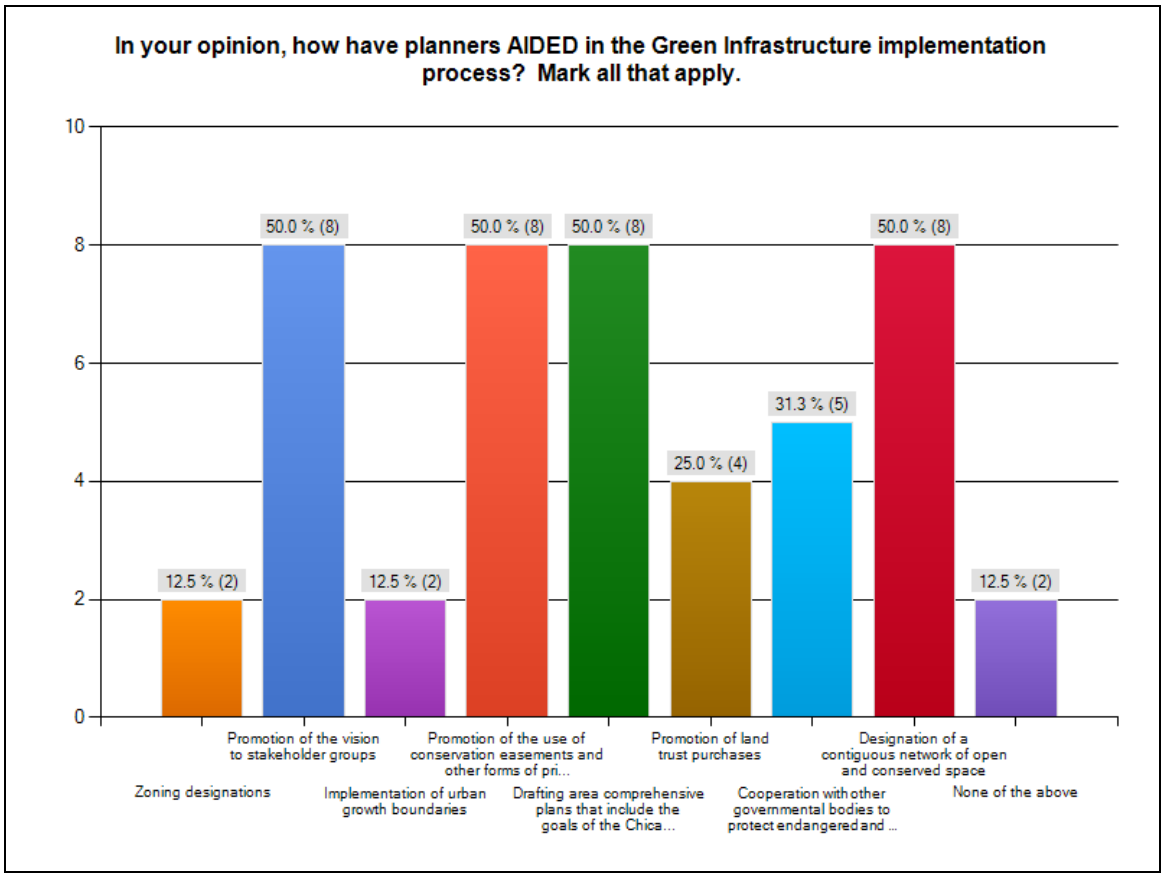

Figure 6: Scientists' Opinions About How Planners Have Aided the Vision

Participants in this path were also asked how planners have failed in the Green Infrastructure implementation process. Of the 16 respondents that answered the question, 12 or 75.0 percent, chose inappropriate or lack of zoning designations the most identifiable way planners have failed to facilitate the implementation of the vision. Additionally, 11 path participants, or 68.8 percent, suggested that lack of implementation of urban growth boundaries is a common

way that planners have failed to implement the Vision. The results are shown in Figure 7: Scientists' Opinions About How Planners Have Failed the Vision. This suggests that Chicagoland planners' failure to implement the Vision is caused by lack of appropriate boundaries to zone and of controlling sprawling development.

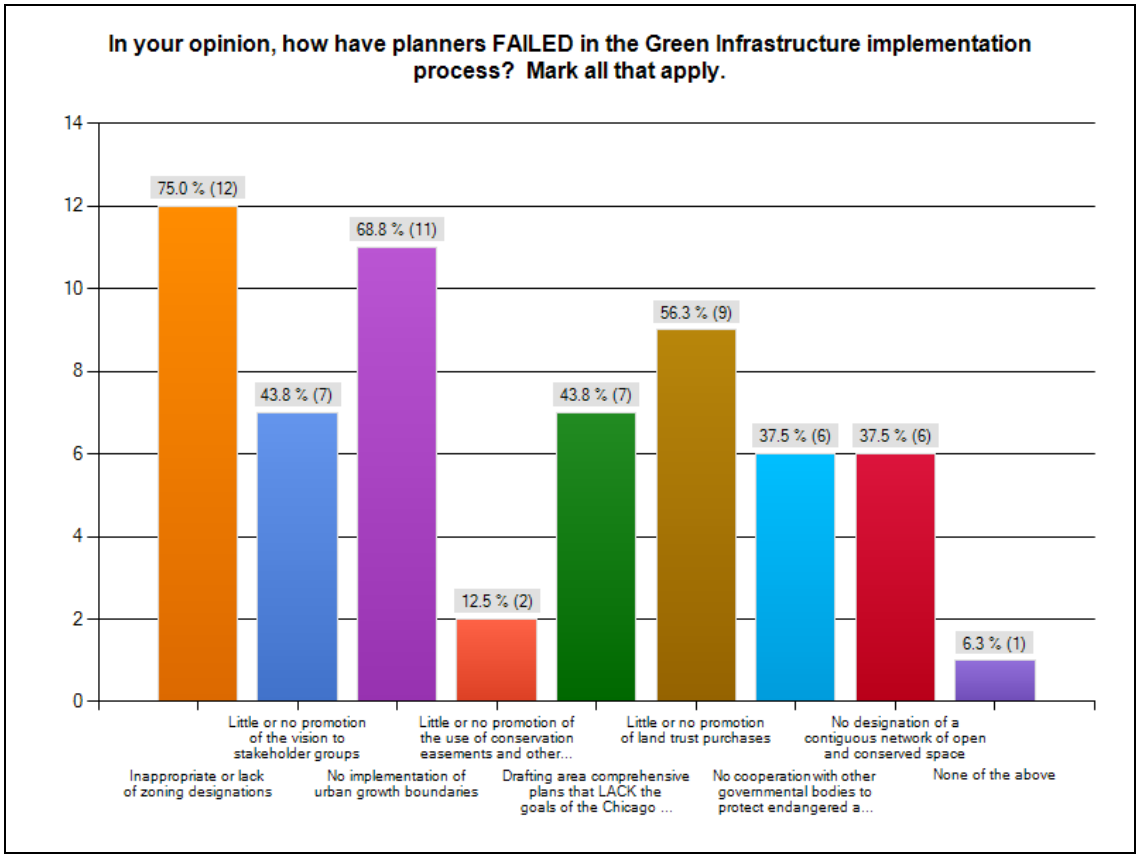

Figure 7: Scientists' Opinions About How Planners Have Failed the Vision

Planner Path Results

Participants that identified themselves as being in the planning field were directed down the planner survey path. They were first asked a series of Likert Scale questions about their personal level of involvement, as well as other planners' roles in the Vision. Of the 21 respondents that completed this path of

the survey, only 10, or 47.6 percent, identified themselves as being involved with the Vision. Six strongly agreed that they were involved.

However, when asked to rank their opinions of whether the Vision is dependent on the participation of planners, 100 percent agreed with 10, or 47.6 percent strongly agreeing. Furthermore, when ranking a statement that planners of all levels are involved in the process, 13 agreed with seven, or 33.3 percent, strongly agreeing. This suggests that although a majority of planners surveyed did not identify themselves as being part of the Vision, all of them have implied that the Vision is dependent upon planners' participation in some aspect.

The planner path was then given another Likert Scale question that asked them to rank statements about themselves, as well as how planning intersects with the Green Infrastructure Vision process. The statements planners were asked to rank included the green infrastructure concepts of biodiversity, ecological footprints, habitat fragmentation and corridors, private land conservation tactics and sustainability. Like the science path, the planner path was also asked to rank statements about planners' roles in perpetuating the Vision and city and county comprehensive plans.

Noticeable trends were found when planners were given a statement about the concept of ecological footprints. When asked to rank their opinion of the statement, "I think it is important to minimize the physical impacts and environmental degradation of a region" 18 out of 21 path respondents, and 85.7 percent, strongly agreed with the other three, 14.3 percent, moderately agreeing.

When asked to rank the statement, “Planners that are involved in the Chicago Green Infrastructure Vision have integral roles in creating, maintaining, and perpetuating the vision” eight out of 21, or 38.1 percent, strongly agreed. The same number of respondents moderately agreed with this question and four, or 19.0 percent, mildly agreed, with only one respondent choosing the Neutral or N/A category. This suggests that planners feel that they are definitely involved in the Vision and that they personally believe in the concept of mitigating environmental degradation.

When asked how comprehensive plans reflect the Vision, participants were prompted to check all of the options that applied. When asked how the Vision was reflected in city comprehensive plans, 75.0 percent or 15 out of 20 respondents to the question identified promotion of the use of conservation easements and other forms of private land conservation as the most obvious contribution. Although 70.0 percent or 14 respondents chose zoning designations, promotion of the vision to stakeholder groups, placing the goals of the Vision into area comprehensive plans, and designation of contiguous networks of open and conserved space as ways in which the plans reflect the vision. The results are shown in Figure 8: Planners' Opinions About How City Comprehensive Plans Reflect the Vision.

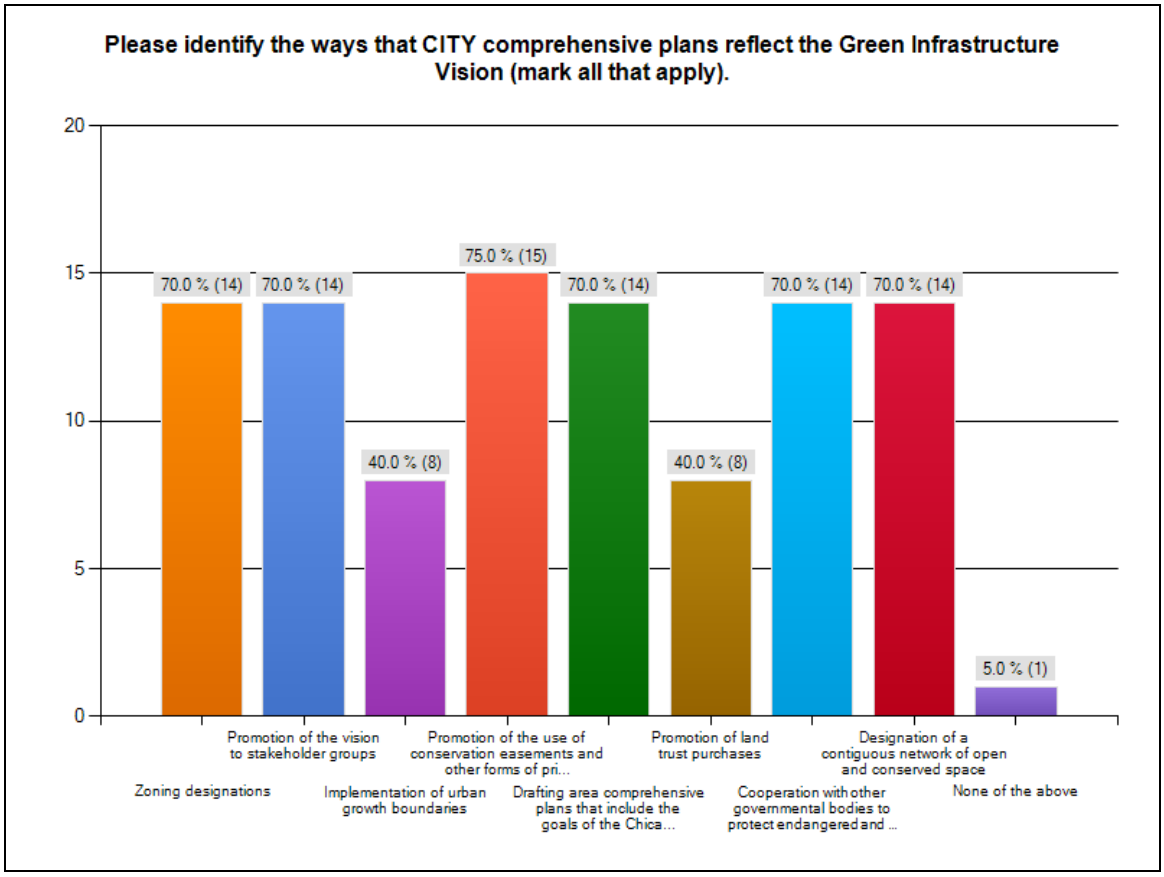

Figure 8: Planners' Opinions About How City Comprehensive Plans Reflect the Vision

When asked how county comprehensive plans reflect the Vision, 88.9 percent, or 16 out of 18 path respondents identified promotion of the vision to stakeholder groups and promotion of the use of conservation easements and other forms of private land conservation as the most obvious contributions. However, 83.3 percent or 15 participants chose both the drafting of area plans with the goals of the Vision included, and the designation of a contiguous network of open and conserved space. The results of this question are shown in Figure 9: Planners' Opinions About How County Comprehensive Plans Reflect the Vision. This suggests that planners feel that they both help to formulate and

implement the Vision by designating conservation lands and drafting area comprehensive plans, respectively.

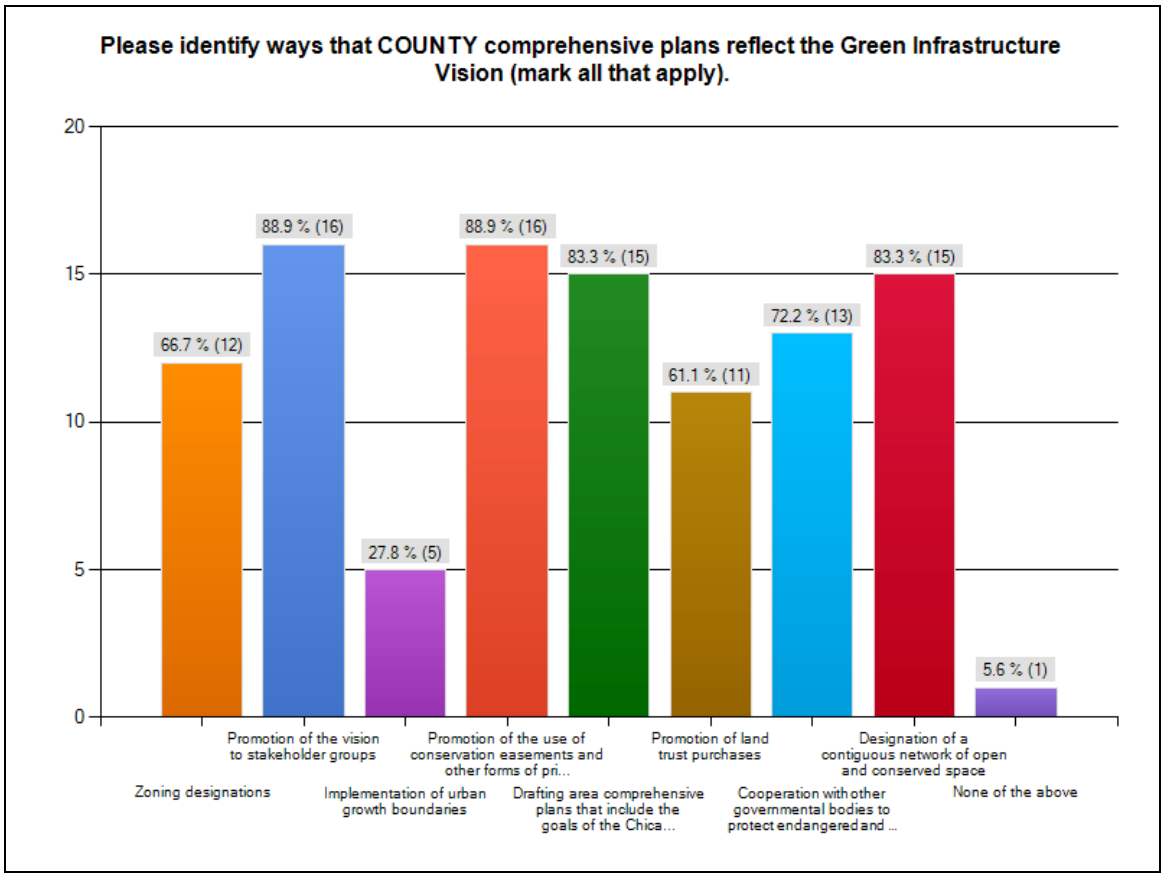

Figure 9: Planners' Opinions About How County Comprehensive Plans Reflect the Vision

There were also noticeable trends when path participants were asked how planners have aided in the Green Infrastructure implementation process. Of the 21 respondents to this question, 16, or 76.2 percent identified the drafting of comprehensive plans that include the goals of the Vision. Additionally, 15, or 71.4 percent of respondents chose promotion of the Vision to stakeholder groups

as ways planners promote the implementation of the Vision. The results are shown in Figure 10: Planners' Opinions About How They Have Aided the Vision. This suggests that area comprehensive plans and plan endorsement to constituents are the primary ways planners feel they have aided the Vision's fruition. Drafting of area comprehensive plans was also identified by the science path as a common way that planners foster its implementation.

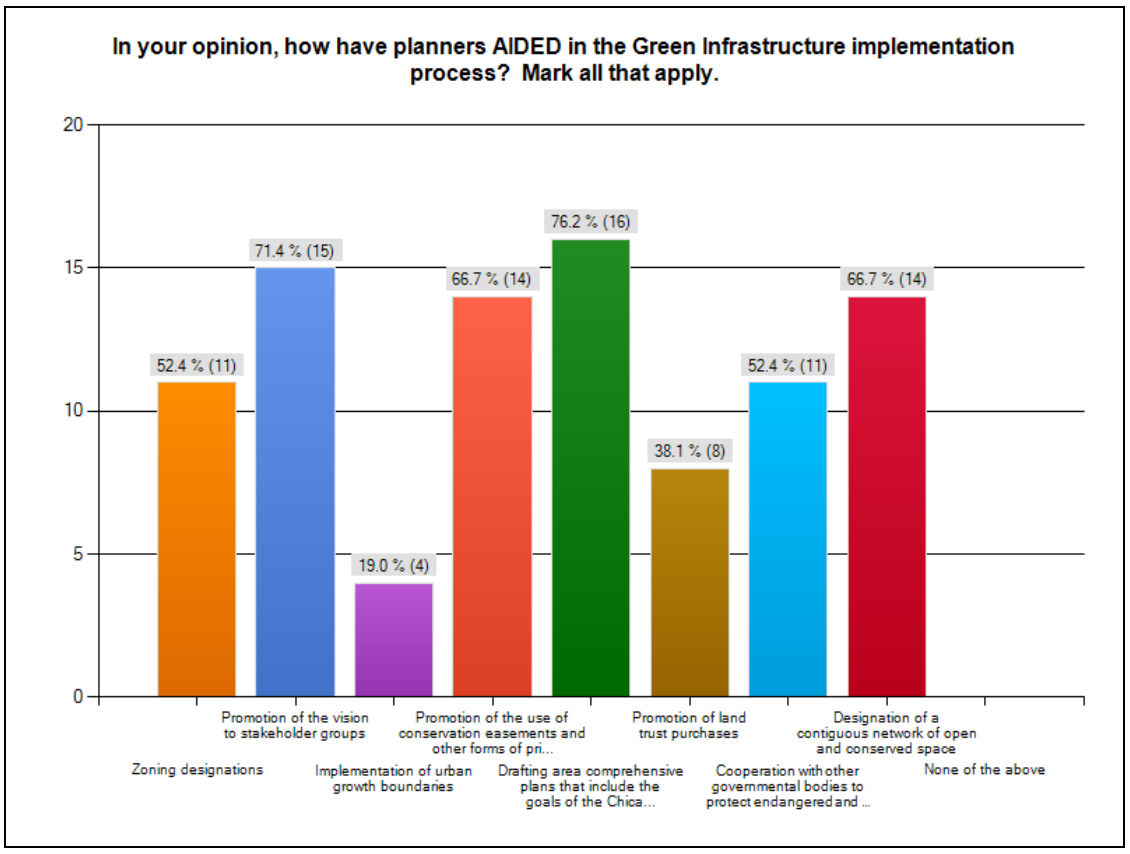

Figure 10: Planners' Opinions About How They Have Aided the Vision

Participants in this path were also asked how planners have failed in the Green Infrastructure implementation process. Of the 21 respondents that

answered the question, 12 or 57.1 percent chose inappropriate or omit of zoning designations as ways that planners have failed to facilitate the implementation of the vision. Additionally, 10 or 47.6 percent suggested that planners have failed to implement the Vision through their drafting of area comprehensive plans that lack its goals. The results are shown in Figure 11: Planners' Opinions About How They Have Failed the Vision.

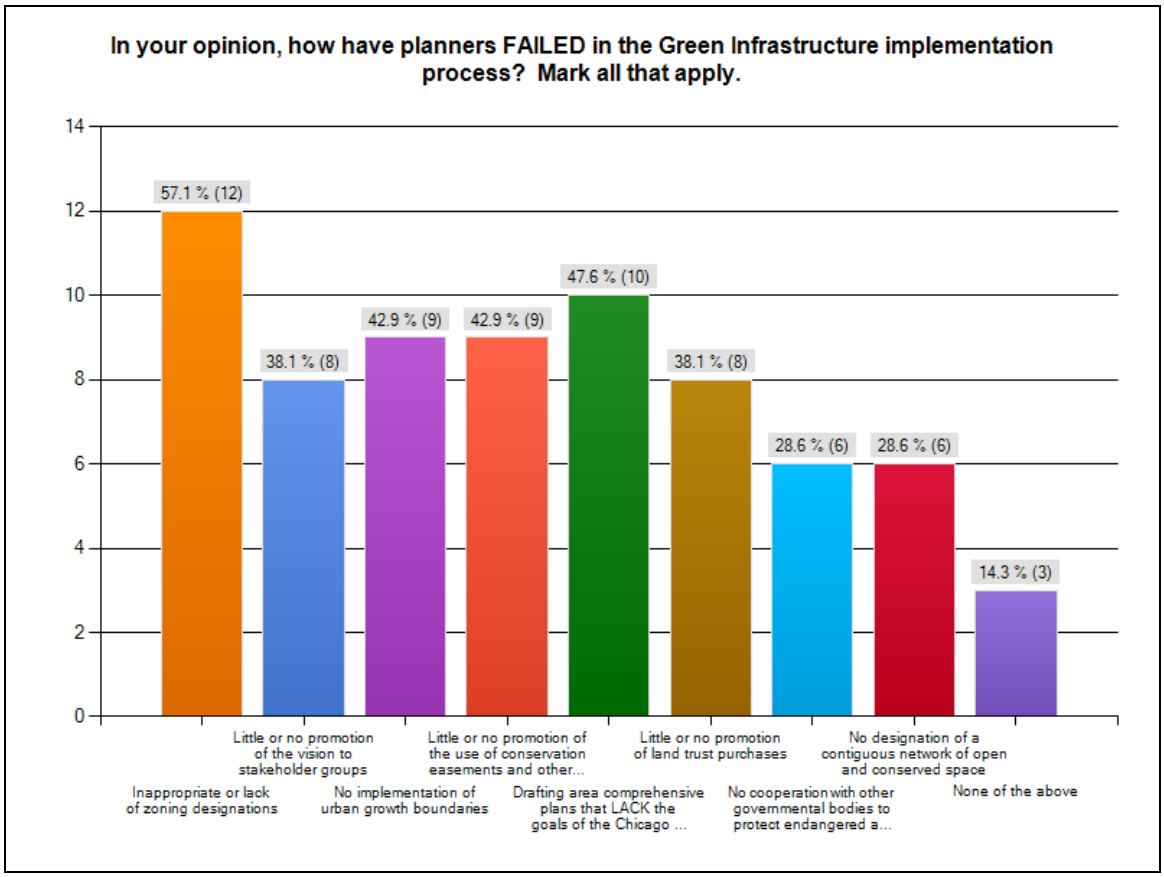

Figure 11: Planners' Opinions About How They Have Failed the Vision

Other Career Path

Those respondents that answered “Other” to the aforementioned career field question were directed down a path of queries intended to reveal the extent of planners’ roles in the green infrastructure implementation process. The first

round of questions used a Likert Scale that asked their level of involvement and knowledge of planners' roles in the Vision. Of the 10 responses to this question, a majority, 60.0 percent, or six participants, identified themselves as being involved with the Chicago Wilderness Green Infrastructure Vision, one chose N/A and three disagreed that they were involved to varying degrees. The same number expressed familiarity with planners' roles in the Vision as shown in Figure 12: Other Path Respondents Familiarity With the Vision. This suggests that of the participants directed down this path, most were both familiar with the Vision, and cognizant of planners' roles in it.

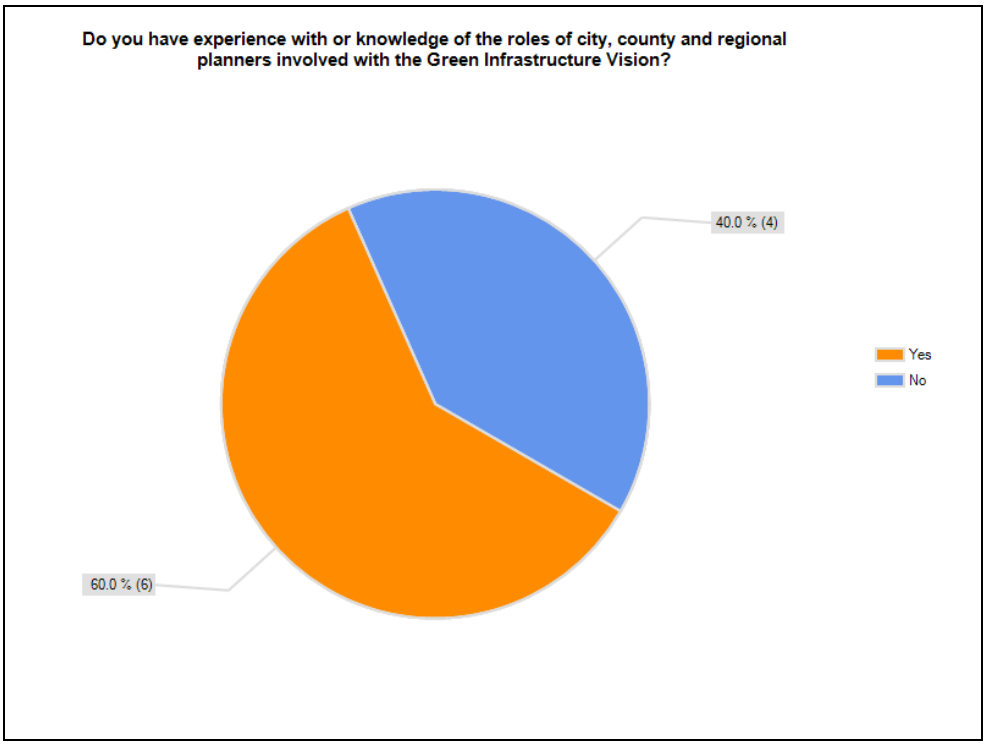

Figure 12: Other Path Respondents Familiarity With the Vision

The path was then given the same Likert Scale question that was asked of the science path. Respondents were asked to rank statements about planners involved in the Green Infrastructure Vision, and the planning field in general. These statements included the green infrastructure concepts of biodiversity, ecological footprints, habitat fragmentation and corridors, private land conservation tactics and sustainability. Additionally, they were asked to rank statements about planners' roles in perpetuating the Vision and city and county comprehensive plans.

There were identifiable trends in the data. When asked to rank whether the planners involved in the Chicago Green Infrastructure Vision are cognizant of the ecological footprint of the Chicago region and attempt to decrease it, 50.0 percent, or five respondents strongly agreed. The same number of respondents strongly agreed that planners that are involved in the Chicago Green Infrastructure Vision have integral roles in creating, maintaining and perpetuating it. Furthermore, the same percentage strongly agreed that planners involved in the Vision promote sustainable design concepts. However, when asked if city comprehensive plans reflect the Vision, 70 percent or seven out of 10 respondents disagreed, with 60 percent or six moderately but none strongly disagreeing. Conversely, 50 percent of the 10 respondents agreed that county comprehensive plans included Vision concepts.

When asked how comprehensive plans reflect the Vision, path participants were prompted to check all of the options that applied. When asked how the

Vision was reflected in city comprehensive plans, 80.0 percent or eight respondents identified designating a contiguous network of open and conserved space as the most obvious contribution. Although 70.0 percent or seven respondents chose zoning designations as a way in which the plans reflect the vision. The results are included in Figure 13: Other Path Respondents' Opinions About How City Comprehensive Plans Reflect the Vision.

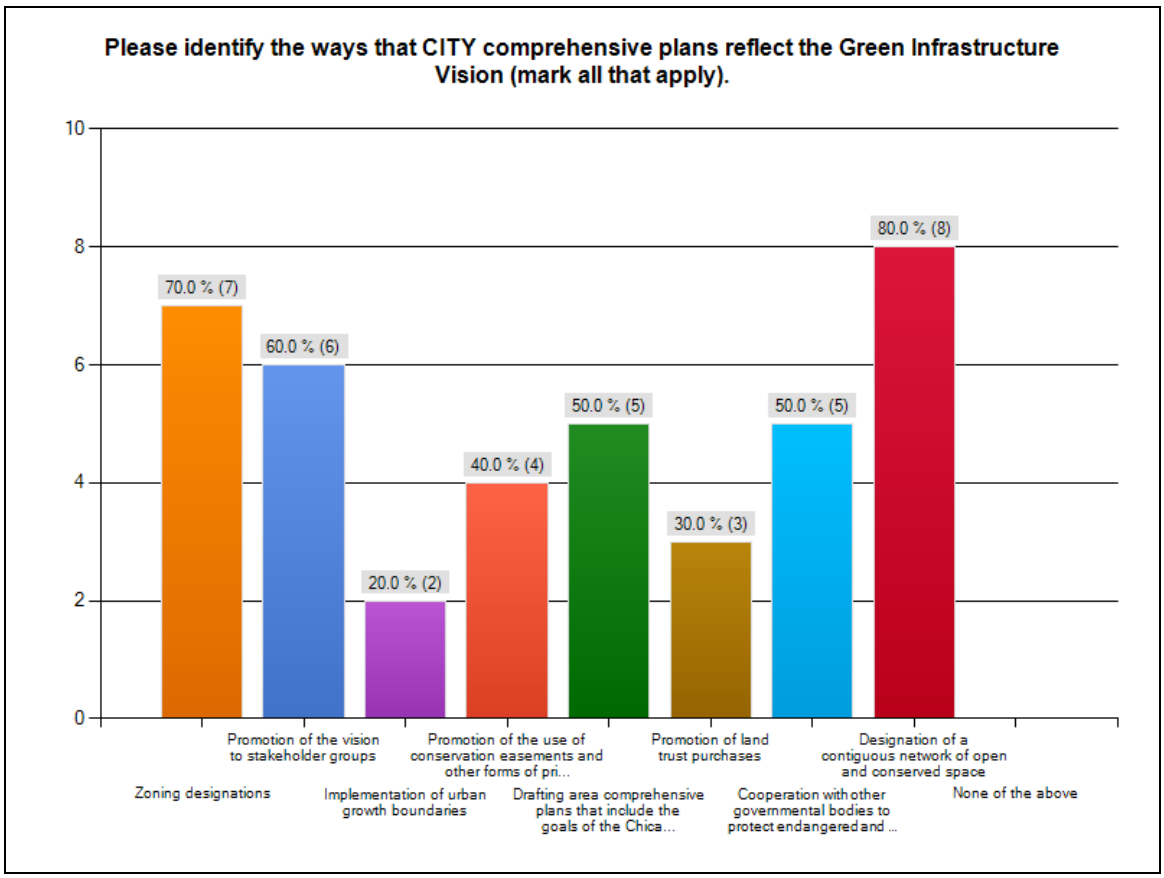

Figure 13: Other Path Respondents' Opinions About How City Comprehensive Plans Reflect the Vision

When asked how county comprehensive plans reflect the Vision, only nine of the path's respondents answered. Again, the majority of participants chose

designation of a contiguous network of open and conserved space as the most obvious contribution with seven, or 77.8 percent choosing this option. The results of this question are shown in Figure 14: Other Path Respondents' Opinions About How County Comprehensive Plans Reflect the Vision.

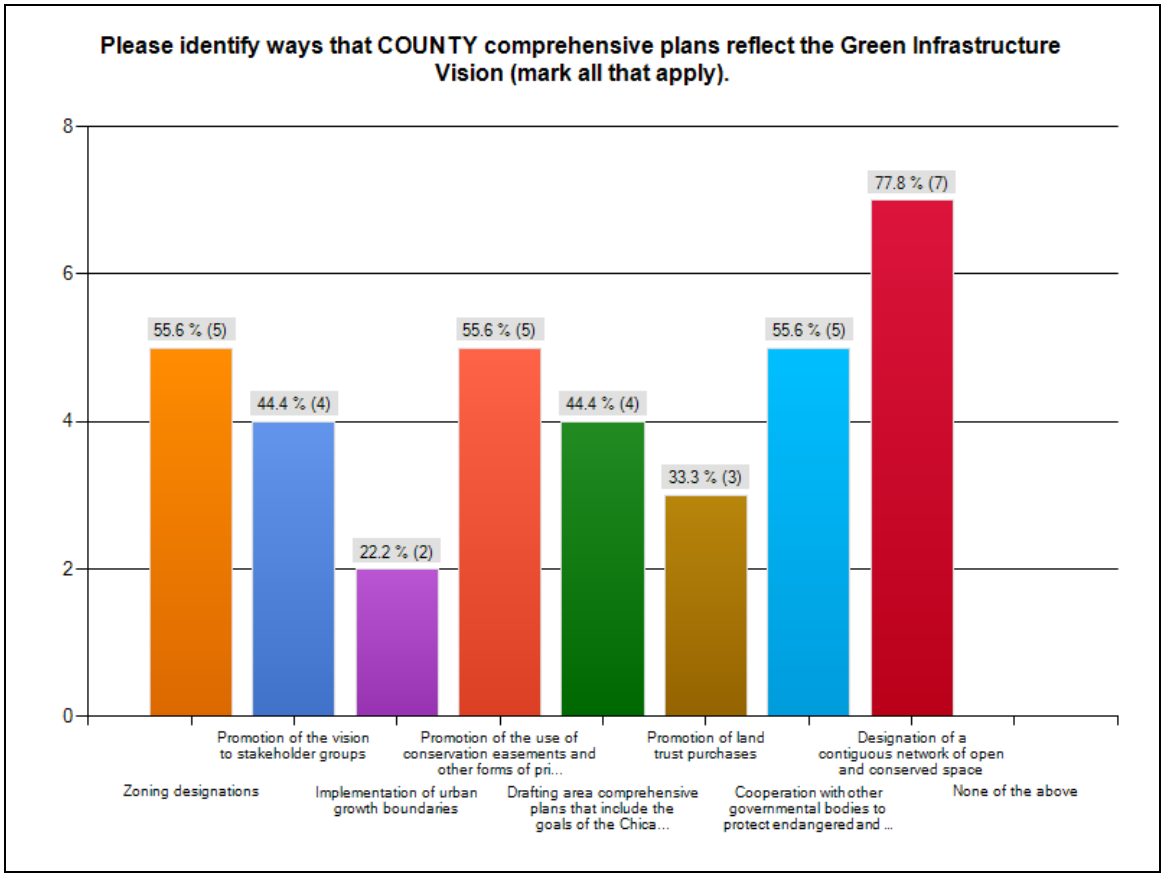

Figure 14: Other Path Respondents' Opinions About How County Comprehensive Plans Reflect the Vision

There were also noticeable trends when path participants were asked how planners have aided in the Green Infrastructure implementation process. Of the 10 respondents to this question, six, or 60.0 percent identified both the drafting of comprehensive plans that include the goals of the Vision and promotion of the vision to stakeholders as the main ways that planners have helped to implement

green infrastructure. Additionally, five, or 50.0 percent of respondents chose promotion of the use of conservation easements and other forms of private land conservation as a way that planners promote the implementation of the vision. This implies that planners have included the Vision's goals into their tasks via comprehensive plans and have an important role in promoting the Vision and its goals to public and private stakeholders. Therefore, this information suggests that planners do play important roles in the Vision's implementation process in different ways. The results are shown in Figure 15: Other Path Respondents' Opinions About How Planners Have Aided the Vision.

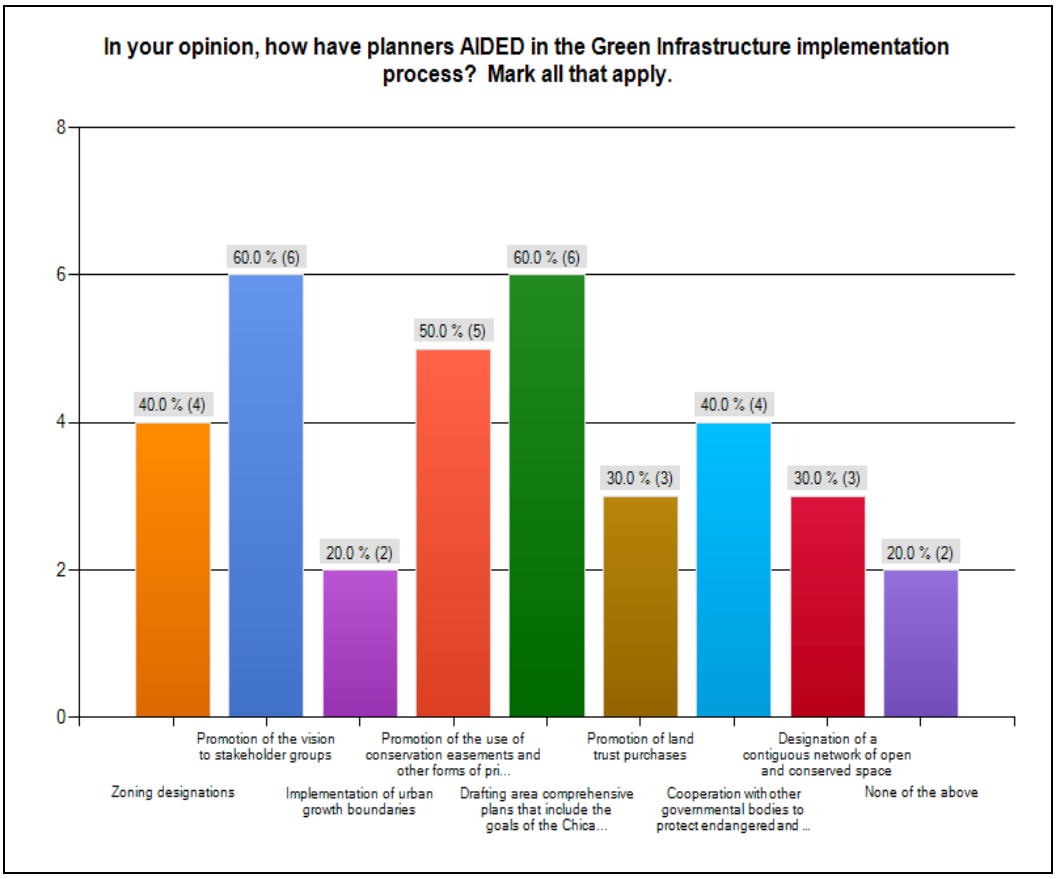

Figure 15: Other Path Respondents' Opinions About How Planners Have Aided the Vision

Participants in this path were also asked how planners have failed in the Green Infrastructure implementation process. Of the 10 respondents that answered the question, six or 60.0 percent chose little or no promotion of the vision to stakeholder groups, little or no promotion of the use of conservation easements and other forms of private land conservation tools, and little or no promotion of land trust purchases as ways planners have failed to facilitate the implementation of the vision. Additionally, five or 50.0 percent suggested that both drafting area comprehensive plans that lack the goals of the Vision and no implementation of urban growth boundaries are ways that planners have failed to implement it. The results are shown in Figure 16: Other Path Respondents' Opinions About How Planners Have Failed the Vision.

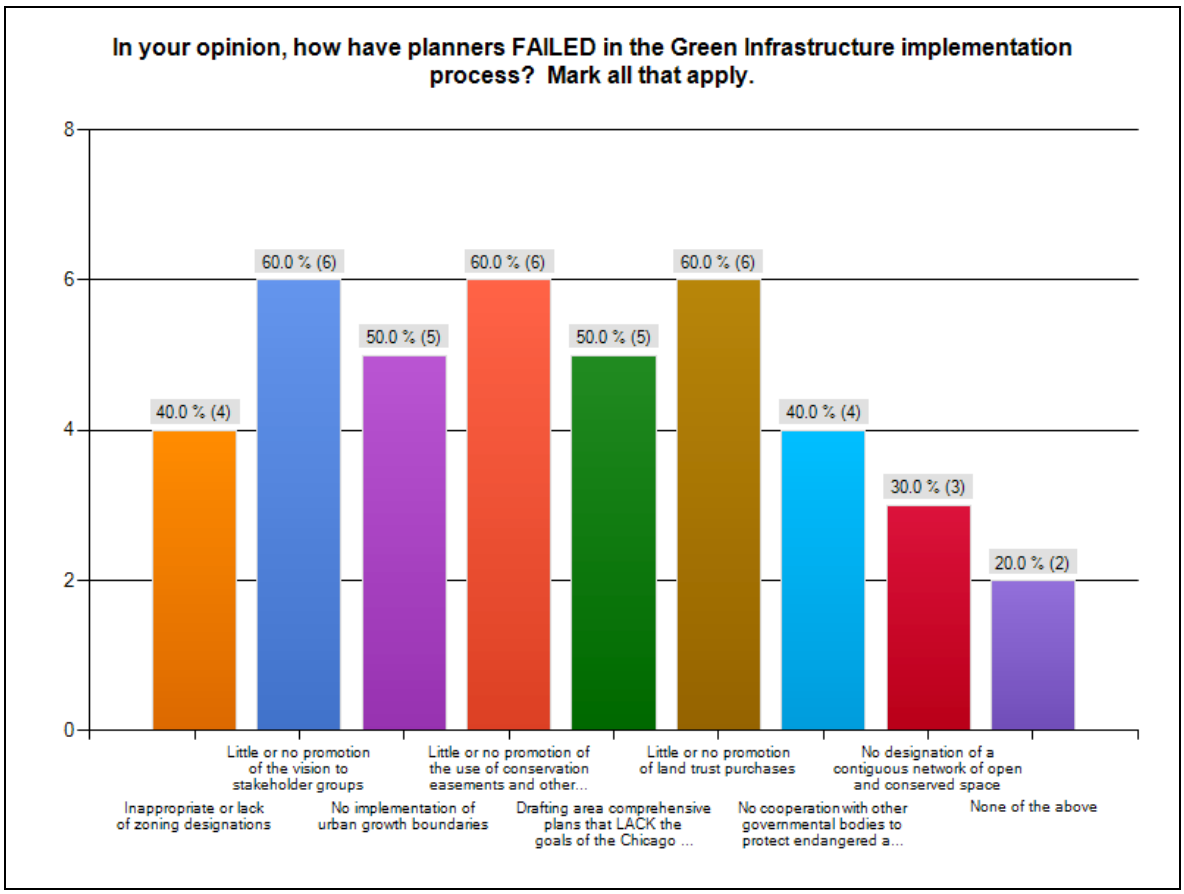

Figure 16: Other Path Respondents' Opinions About How Planners Have Failed the Vision

Green Infrastructure Concept Path

Those respondents that answered "No" to being familiar with the Chicago Wilderness Green Infrastructure Vision at the beginning of the survey were redirected to a path that asked them questions about conservation systems as a whole. Like the other paths, the questions asked of these respondents were focused on their opinions of planners' roles in creating networks of open and conserved space, as well as common green infrastructure concepts. There was a survey logic question that asked if participants had knowledge of (and/or experience with) systems designed to conserve land. Only one out of 11

respondents answered “No” to this question. The participant was redirected to the end page where they were thanked for their participation.

The first set of questions for remaining participants was a Likert Scale. Of the 11 original redirections down this path, six respondents completed the survey. As with the other paths, participants were asked to rank statements having to do with their involvement in conservation systems and their knowledge of the role of planners in creating networks of conserved land. Only three, or 50.0 percent of respondents identified themselves as being involved with the formulation of a conservation network. However, five out of five of the respondents that rated the statement of planners’ roles in creating conservation systems identified as being familiar with them.

This path was then given another Likert Scale question that asked them to rank statements regarding planners in general. These statements included the green infrastructure concepts of biodiversity, ecological footprints, habitat fragmentation and corridors, private land conservation tactics and sustainability. Additionally, this path was asked to rank statements about planners’ roles in perpetuating land conservation in city and county comprehensive plans.

There were identifiable trends in the data. When asked to rank whether planners conserve lands in order to foster biodiversity, 100.0 percent of the six respondents agreed, two strongly, three moderately, and one mildly. Likewise, 100.0 percent of the six path participants suggested that planners involved in land conservation network design are concerned with the need to connect

landscapes. Finally, when asked to respond to the statement, “planners have integral roles in creating, maintaining and perpetuating networks of conserved land”, five out of six or 83.3 percent agreed, three strongly and two moderately. This suggests that it is the opinion of professionals familiar with conservation networks that planners aid in conserving land and connecting hubs.

When asked how comprehensive plans reflect the Vision, participants were prompted to check all of the options that applied. When asked how land conservation networks are reflected in city comprehensive plans, 100.0 percent or six respondents identified zoning designations as the most obvious contribution. When asked how county comprehensive plans reflect these systems, 83.3 percent, or five respondents, identified zoning and the designation of contiguous patches of open space as the most obvious contributions.

The path’s participants were then asked how planners have aided and failed the land conservation process. Of the six that answered, 83.3 percent, or five, chose promotion of the use of conservation easements and other forms of private land conservation as the most common way planners aid this process. Also, interestingly, three out of six, or 50.0 percent of the path’s respondents said that planners have not failed in the designation of conservation land networks with none specifying another way in which planners may fail.

The survey findings suggest that planners do play a role in the formulation and implementation of green infrastructure visions. The majority of survey respondents identified the drafting of area comprehensive plans, which include

the goals of the Vision as the way that planners most commonly aid in its implementation and promotion. The review of area comprehensive plans suggested that the goals of the Vision were included in the area's regional, county and local plans. However, to determine if the lands set aside for conservation actually promote biodiversity concepts, a gap analysis was conducted.

Gap Analysis

Intent

The purpose of creating a gap analysis was to discern from spatial data those lands that are most critical to the biodiversity of the Chicago Metropolitan Region. This was assessed by two criteria: the most critical habitat for wildlife, as well as the presence of species. The analysis findings will be compared with spatial data that maps identified lands of interest for inclusion in the Chicago Wilderness Green Infrastructure Vision. The combined analysis will yield a determination of whether green infrastructure visions in cities with a metropolitan population of over one million residents can be successful from a functional perspective.

Criteria and Process

To formulate a gap analysis model for such a diverse area, certain criteria were used. These included species richness, land cover classifications, slope, riparian areas, protected areas and non-urban areas. The data was compiled from several different sources and aligned to match the study area. These

included the Illinois Data Clearinghouse, the U.S. Fish and Wildlife Service, and the USGS National Gap Analysis website. All layers were combined and clipped to the six county study area.

Non-Urbanized Areas

Urbanized areas were considered avoidances for the sake of this model. Therefore, the shapefile for the study area's municipalities was reclassified with non-municipal areas being of the highest importance, and municipalities having no weight. Urban areas were scored zero and non-urbanized areas were scored a five.

Protected Areas

The higher the volume of natural landscapes in a given area, the higher the probability of maintaining or reestablishing connectivity, which is essential to the maintenance of biodiversity (Forman, 2008, p. 148). Data on the study area's conserved lands was acquired through the Nature Conservancy's C.A.R.L. (conservation and recreation land) database and Ducks Unlimited's protected areas spatial database. These areas were considered existing contiguous patches for the purposes of this model. Conservation or recreational lands were scored according to their acreage. Lands that were not protected were scored a value of zero in the reclassification. Those between 0 and 100 acres were scored a value of one, while those that were between 100 and 1,000 acres were valued at a two. Areas between 1,000 and 10,000 acres and those between

10,000 and 100,000 acres were valued three and four respectively. Areas given the most weight were those that encompassed over 100,000 acres.

Riparian Areas

Connections are particularly important in urban areas because landscapes become separated (Forman, 2008, p. 147). In conservation visions, water bodies are both connections, and a necessary component of biodiversity maintenance. The degradation of water because of contamination from sedimentation, chemicals and the heat island effect is common in urban areas. Establishing a system of water corridors and vegetation is a priority when designating conservation land (Forman, 2008, p. 156).

Wetlands are also important because of the natural functions they provide, including reducing floodwaters, breaking down chemicals, biodiversity support, and recreational uses (Forman, 2008, p. 149). Taking this into consideration, the riparian areas layer was comprised of streams, floodplains, hydrology and wetlands. The data were acquired from the U.S. Fish and Wildlife Service's National Wetlands Inventory, as well as the Illinois Data Clearinghouse. After these shapefiles were merged, the layer was converted to raster. It was then reclassified with all water bodies being ranked 5 and all areas outside of riparian systems assigned a 0 value.

Species Richness

The species richness data was acquired through United States Geological Survey's (USGS) National Gap Analysis program website. Files for amphibian,

mammal, migratory bird, reptile, permanent bird, summer bird and winter bird richness were used. A table of the reclassified values based on number of species in areas located within the study region is included in Table 3: Study Area Species Richness.

Table 3: Study Area Species Richness

Layer	0	1	2	3	4	5
Amphibian Richness	NoData	0-5	5-10	10-15	15-20	20-28
Mammal Richness	NoData	0-7	7-14	14-21	21-28	28-38
Migratory Bird Richness	NoData	0-34	34-68	68-102	102-136	136-171
Reptile Richness	NoData	0-7	7-14	14-21	21-28	28-36
Permanent Bird Richness	NoData	0-6	6-12	12-18	18-24	24-32
Summer Bird Richness	NoData	0-15	15-30	30-45	45-60	60-73
Winter Bird Richness	NoData	0-15	15-30	30-45	45-60	60-77

Land Cover

The more natural landscapes and landscape types that are present, the more diversity of food products there are available for species and the greater the chances of the land being viable for the future (Forman, 2008, p. 151). Keeping this in mind, it was important to include the Illinois land cover dataset, acquired through the USGS National Gap Analysis Program website. This shapefile provides data on the vegetation type found within the study area. The different land cover classifications were reclassified to weight those that promote biodiversity more highly than others. Agriculture lands, high density urban, surface water and barren and exposed lands were given a value of one and low and medium density urban land classes were given a value of two. Rural grassland, coniferous forest, urban open space, and partial canopy/savanna

upland forest were given a value of three. The dry upland forest, dry-mesic upland forest, mesic upland forest, wet-mesic floodplain forest, wet floodplain forest, and seasonal and temporarily flooded wetland land classes were given a value of four. The shallow marsh/wet meadown, deep marsh, and shallow water wetland classes were given a value of five.

Slope

Maintaining vegetation on slopes has many benefits including "high visual quality, good recreation opportunities, and rich biodiversity" even close to metropolitan areas (Forman, 2008, p. 157). Higher slopes are therefore more suitable for the persistence of species. Slopes that had a 0-3 percent incline were given a value of one, 3-6 percent a value of two, 6-9 percent a value of three, 9-12 percent a value of four and 12-15.5 percent a value of five. This data was acquired from the Illinois Data Clearinghouse.

Output

As seen in Table 4: Gap Analysis Layer Weights and Table 5: Gap Analysis Reclassifications, the aforementioned criteria were reclassified and then weighted. Because of the importance of protecting species, food, and bedding, species richness, protected hubs, and riparian areas were assigned the highest value of three. The land cover and non-urbanized area data was given a value of two. Because of the relatively flat area, slope was assigned a value of one.

Table 4: Gap Analysis Layer Weights

Layer	Weight
Amphibian Richness	3
Mammal Richness	3
Migratory Bird Richness	3
Reptile Richness	3
Permanent Bird Richness	3
Summer Bird Richness	3
Winter Bird Richness	3
Land Cover	2
Slope	1
Riparian Areas	3
Ducks Unlimited Protected Areas	3
CARL Protected Areas	3
Urban Areas	2

Table 5: Gap Analysis Reclassifications

Layer	0	1	2	3	4	5
Amphibian Richness	NoData	0-5	5-10	10-15	15-20	20-28
Mammal Richness	NoData	0-7	7-14	14-21	21-28	28-38
Migratory Bird Richness	NoData	0-34	34-68	68-102	102-136	136-171
Reptile Richness	NoData	0-7	7-14	14-21	21-28	28-36
Permanent Bird Richness	NoData	0-6	6-12	12-18	18-24	24-32
Summer Bird Richness	NoData	0-15	15-30	30-45	45-60	60-73
Winter Bird Richness	NoData	0-15	15-30	30-45	45-60	60-77
Land Cover	NoData	Agriculture Lands, High Density Urban, Surface Water and Barren and Exposed Land	Low/Medium Density Urban, Medium Density Urban, and Low Density Urban	Rural Grasslands, Coniferous Forest, Urban Open Space, and Partial Canopy/Savanna Upland Forest	Dry Upland Forest, Dry-Mesic Upland Forest, Mesic Upland Forest, Wet-Mesic Floodplain Forest, Wet Floodplain Forest, and Seasonal and Temporarily Flooded Wetlands	Shallow Marsh/Wet Meadow, Deep Marsh, and Shallow Water Wetland
Slope	NoData	0-3 percent	3-6 percent	6-9 percent	9-12 percent	12-15.5 percent
Riparian Areas	NoData	N/A	N/A	N/A	N/A	Riparian Areas
Ducks Unlimited Protected Areas	NoData	0-100 acres	100-1,000 acres	1,000-10,000 acres	10,000-100,000 acres	100,000+ acres
CARL Protected Areas	NoData	1-100 acres	100-1,000 acres	1,000-10,000 acres	10,000+ acres	N/A
Urban Areas	Urban Areas	N/A	N/A	N/A	N/A	Non-urban areas

The final output is visualized in Figure 17: Chicago Metropolitan Area Gap Analysis. As shown in this figure, the most sensitive lands are located outside of the City of Chicago because it is less populated and developed. There are noticeably large patches of sensitive land around riparian areas and already designated conservation lands in all of the six counties. In Figure 18: Gap Analysis and Green Infrastructure Vision**,** we can see the Vision's identified lands of interest juxtaposed with the gap analysis.

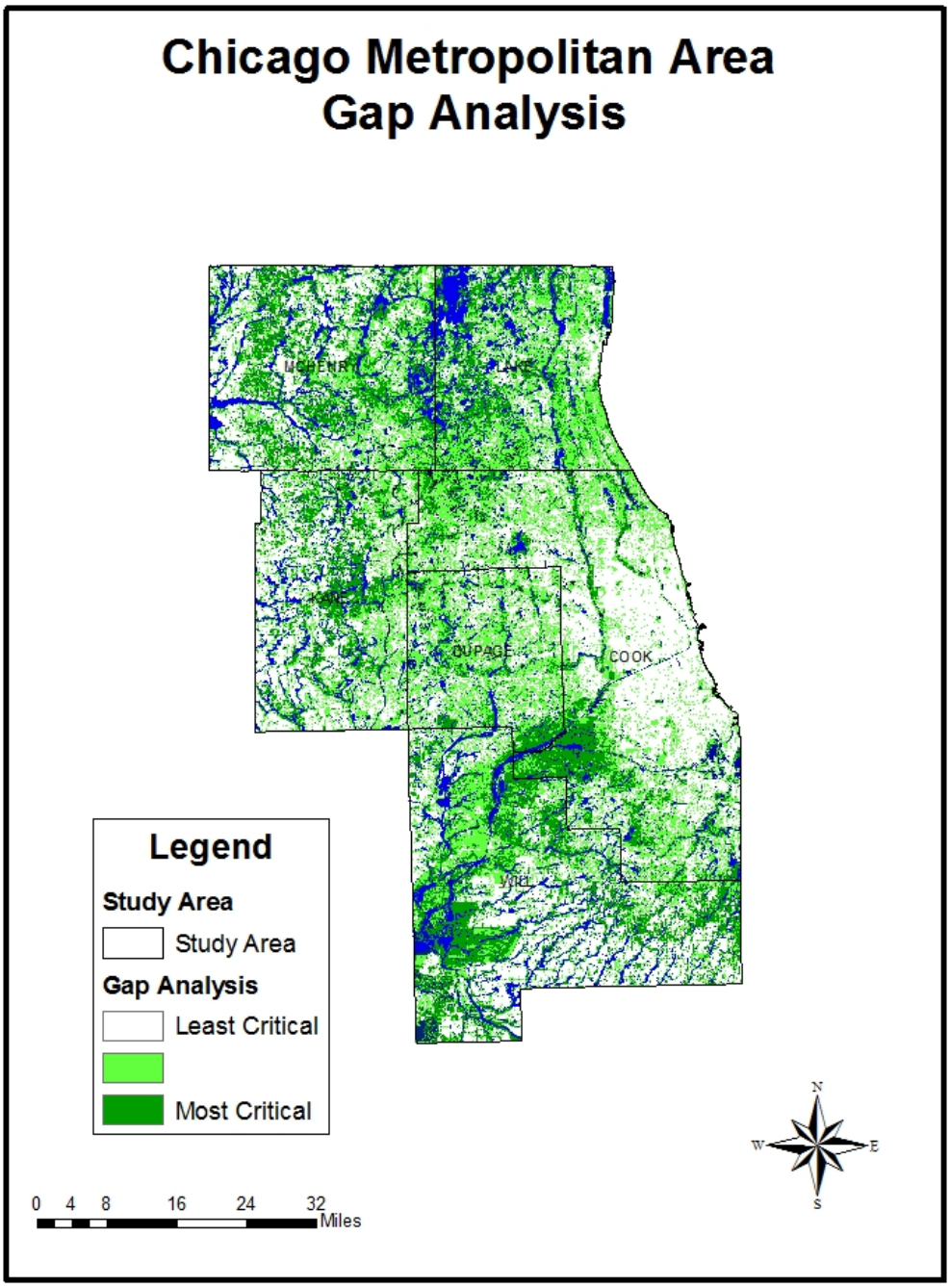

Figure 17: Chicago Metropolitan Area Gap Analysis

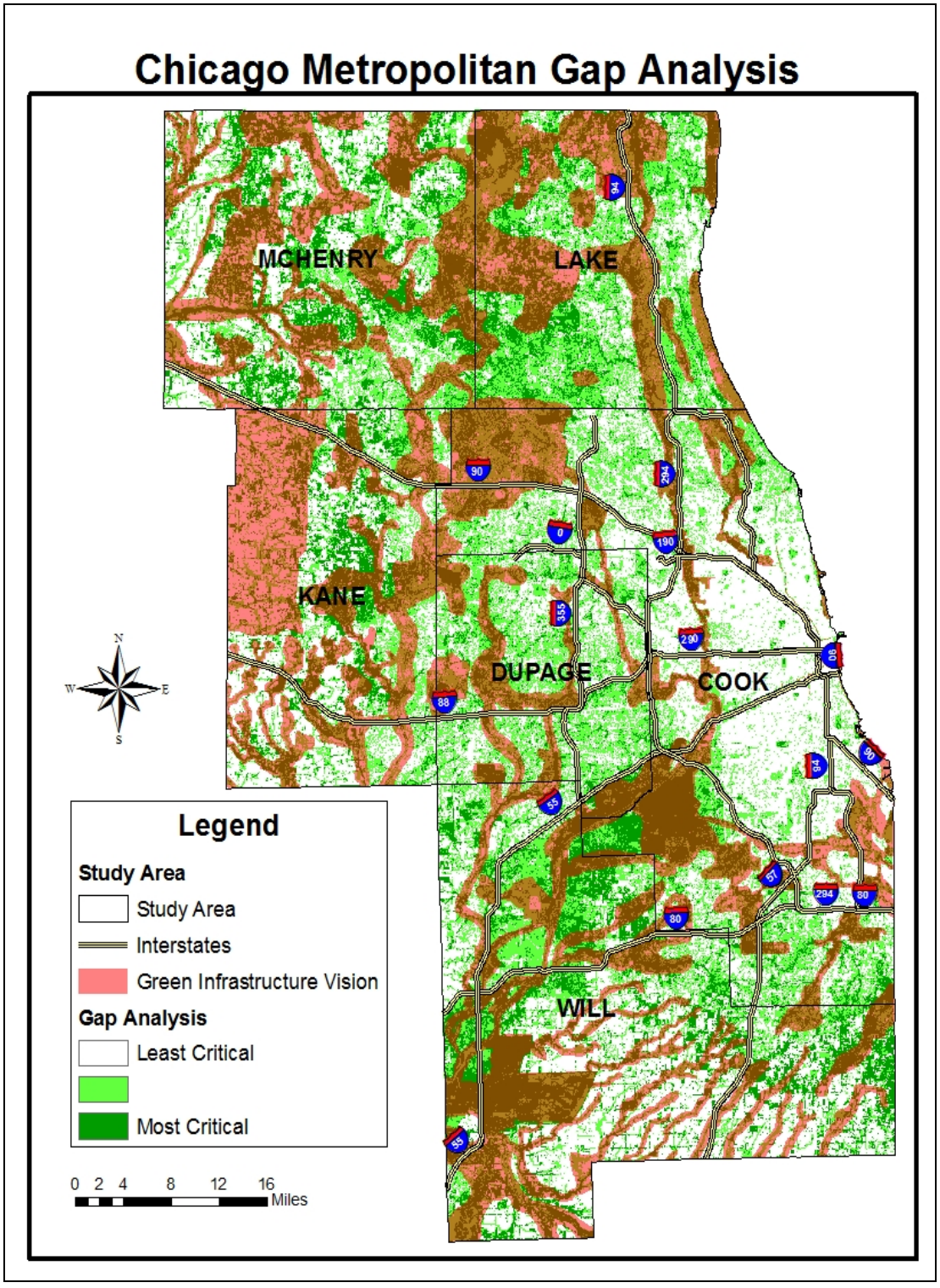

Figure 18: Gap Analysis and Green Infrastructure Vision

An analysis of the amount of overlap between the Green Infrastructure Vision, this study's gap analysis, and riparian areas was done in an effort to determine if the concepts behind this gap analysis were included in the design of the Vision. Table 6: Green Infrastructure Vision and Gap Analysis Comparison and Reclassification shows the categories of the comparison after the Vision, the gap analysis, and riparian areas were combined. Table 6 also shows the reclassification done to assess the land that was the most environmentally important and had the most overlap between the aforementioned three criteria. Figure 19: Gap Analysis and GIV Comparison shows the entire study area and denotes the lands with the most overlap of importance and Figure 20: Overlap Categories shows the location of the areas with the most ecological significance and the criteria that they meet. As the outputs display, the Vision was clearly designed in an effort to choose the most environmentally significant lands for inclusion.

Table 6: Green Infrastructure Vision and Gap Analysis Comparison and Reclassification

Overlap Type	Value	Reclassification
In the Vision and a Riparian Area but Less Critical to the Gap Analysis	1	2
In the Vision and a Riparian Area	2	1
In the Vision but Less Critical to the Gap Analysis	3	1
In the Vision Only	4	1
Less Critical to the Gap Analysis	5	1
Critical to the Gap Analysis Only	6	2
In a Riparian Area but Less Critical to the Gap Analysis	7	1
Critical to the Gap Analysis and in a Riparian Area	8	2
Not in any category	9	0
In the Vision and Critical to the Gap Analysis	10	2
In the Vision and a Riparian Area and Critical to the Gap Analysis	11	3
Only in a Riparian Area	12	1

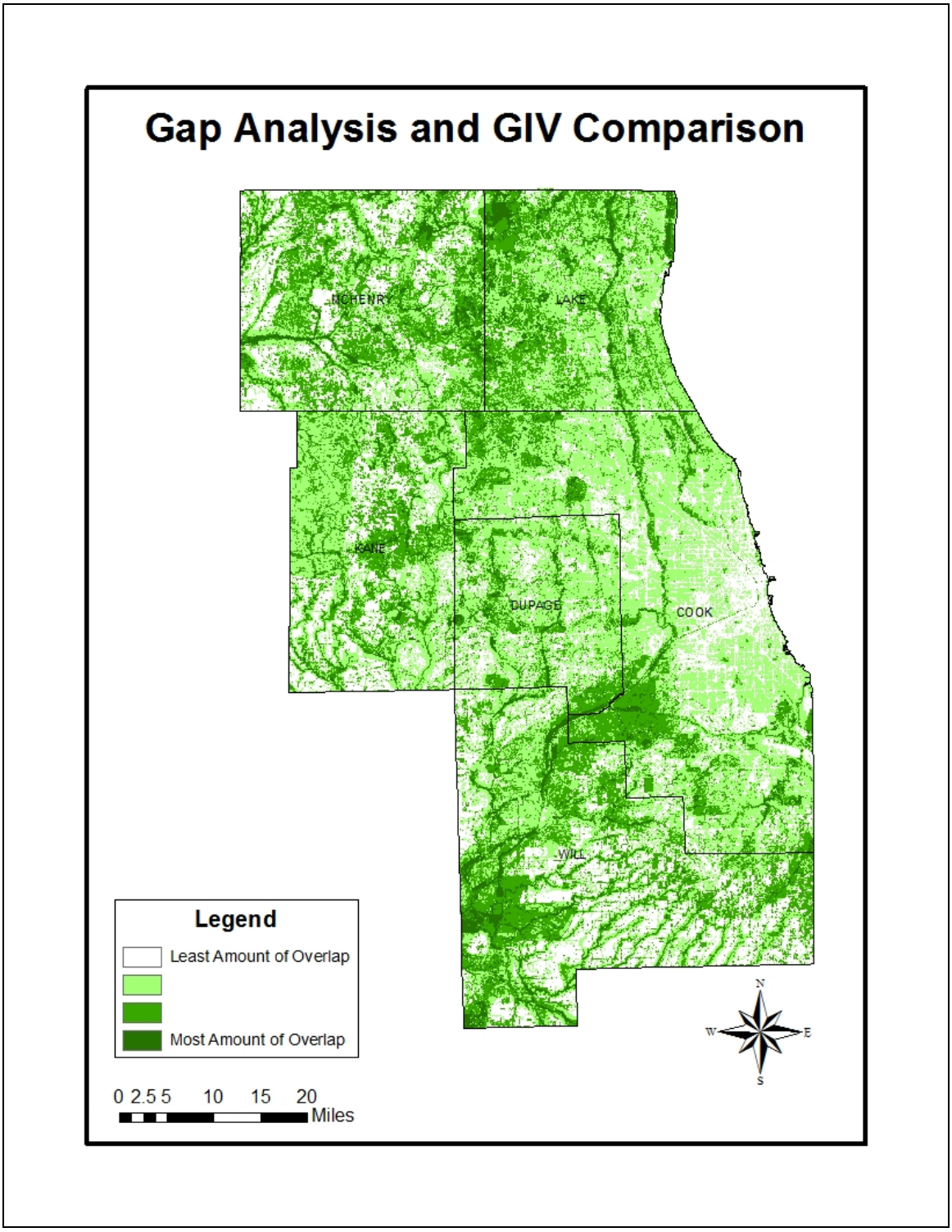

Figure 19: Gap Analysis and GIV Comparison

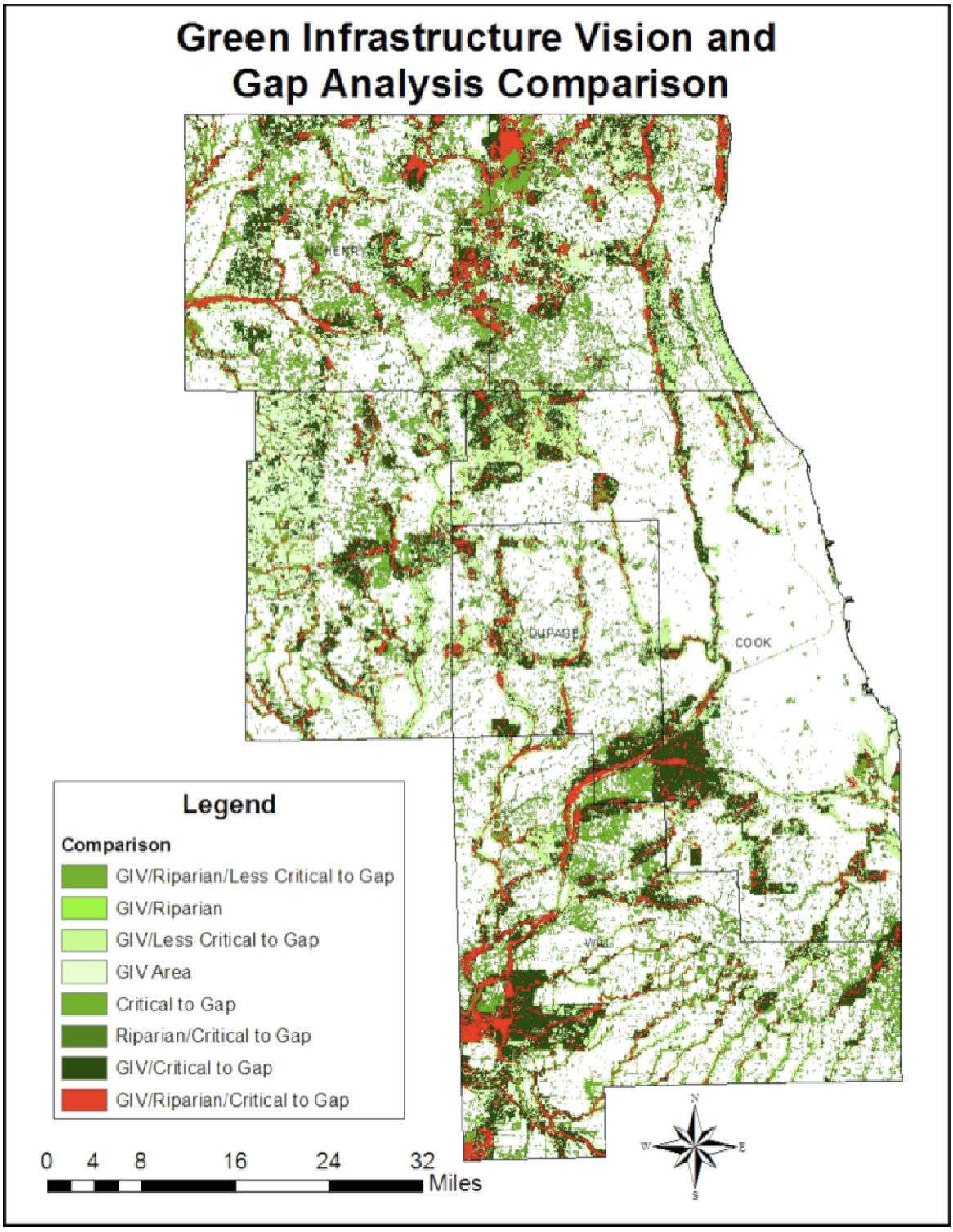

Figure 20: Overlap Categories

Summary

As is evident from the previous map, the Chicago Wilderness identified lands of conservation interest are commensurate with the gap analysis research. There are also many potential corridors identified in the Vision and our analysis, the majority of which are riparian areas. This evidence suggests that the Vision was designed with the intent to preserve ecological functionality of landscapes.

However, there are specific areas that are not included and should be from an ecological and biodiversity perspective. In Figure 21: Illinois and Michigan Canal, it is apparent that there are unprotected significant lands along the Illinois and Michigan Canal. Some of the largest hubs are identified in the map and are areas that have high species richness and/or could serve as important hubs or corridors.

Figure 22: Gaps in Conservation denotes some areas of interest in the northern counties of the study area. The western portion of Kane County has a large hub identified as potential green infrastructure land. However, from the gap analysis it is obvious that this land is not the most ecologically significant for biodiversity maintenance. That is not to say that this land should not be included in the Vision, but simply that this is an example of conservation land that serves a more structural role than a functional one. Conversely, there are several areas that have high species richness and/or would serve as important hubs or corridors in these less populated areas of the region. Some of the most environmentally significant are circled in the figure.

The same areas were examined more closely in the comparison of the Vision, gap analysis and riparian areas. Figure 23: Illinois and Michigan Canal Overlap shows the Illinois and Michigan Canal area and Figure 24: Northern Study Area Overlap shows the northern portion of the study area. As exhibited in the figures, it is again apparent that the Vision was designed to maintain the aforementioned gap analysis concepts.

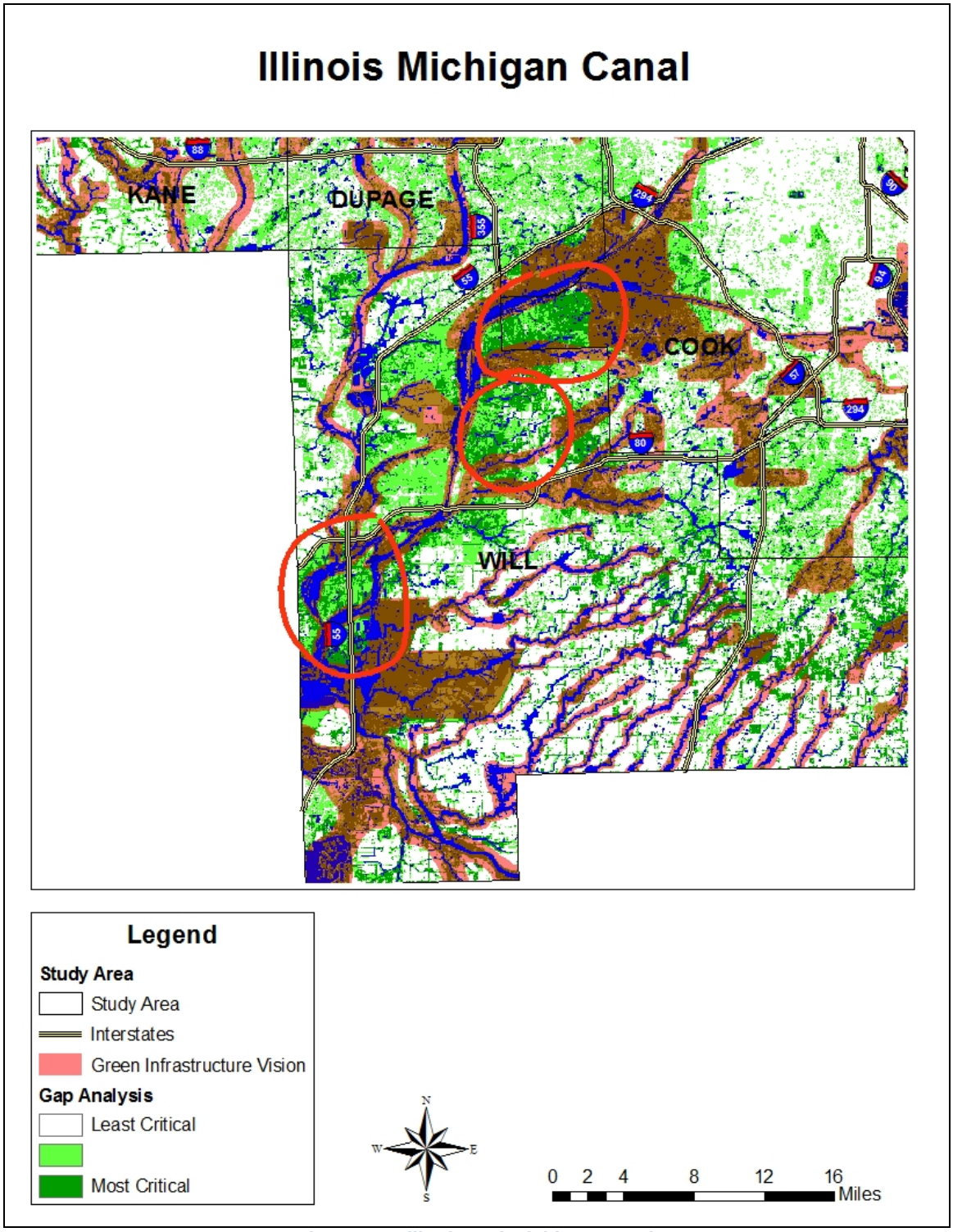

Figure 21: Illinois and Michigan Canal

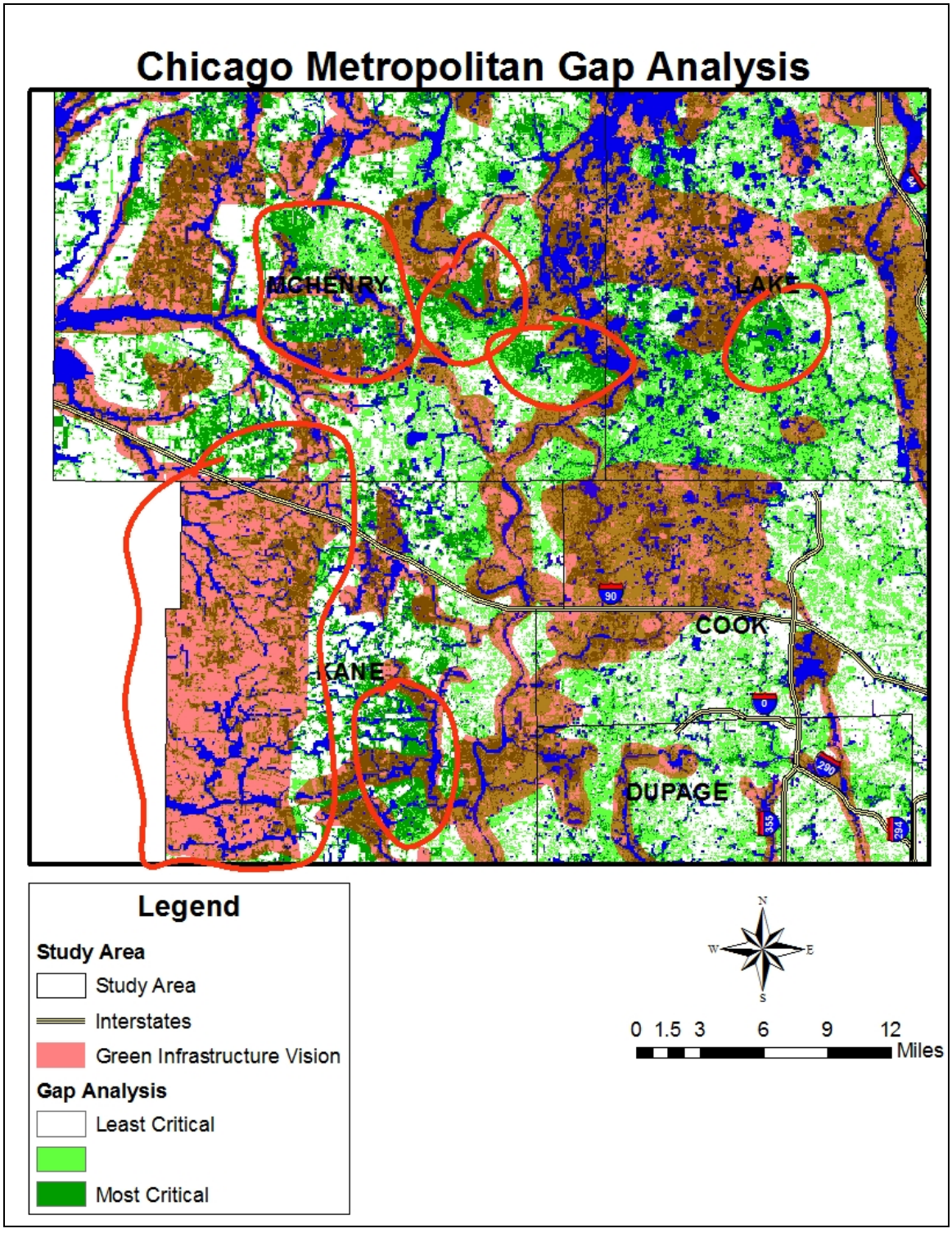

Figure 22: Gaps in Conservation

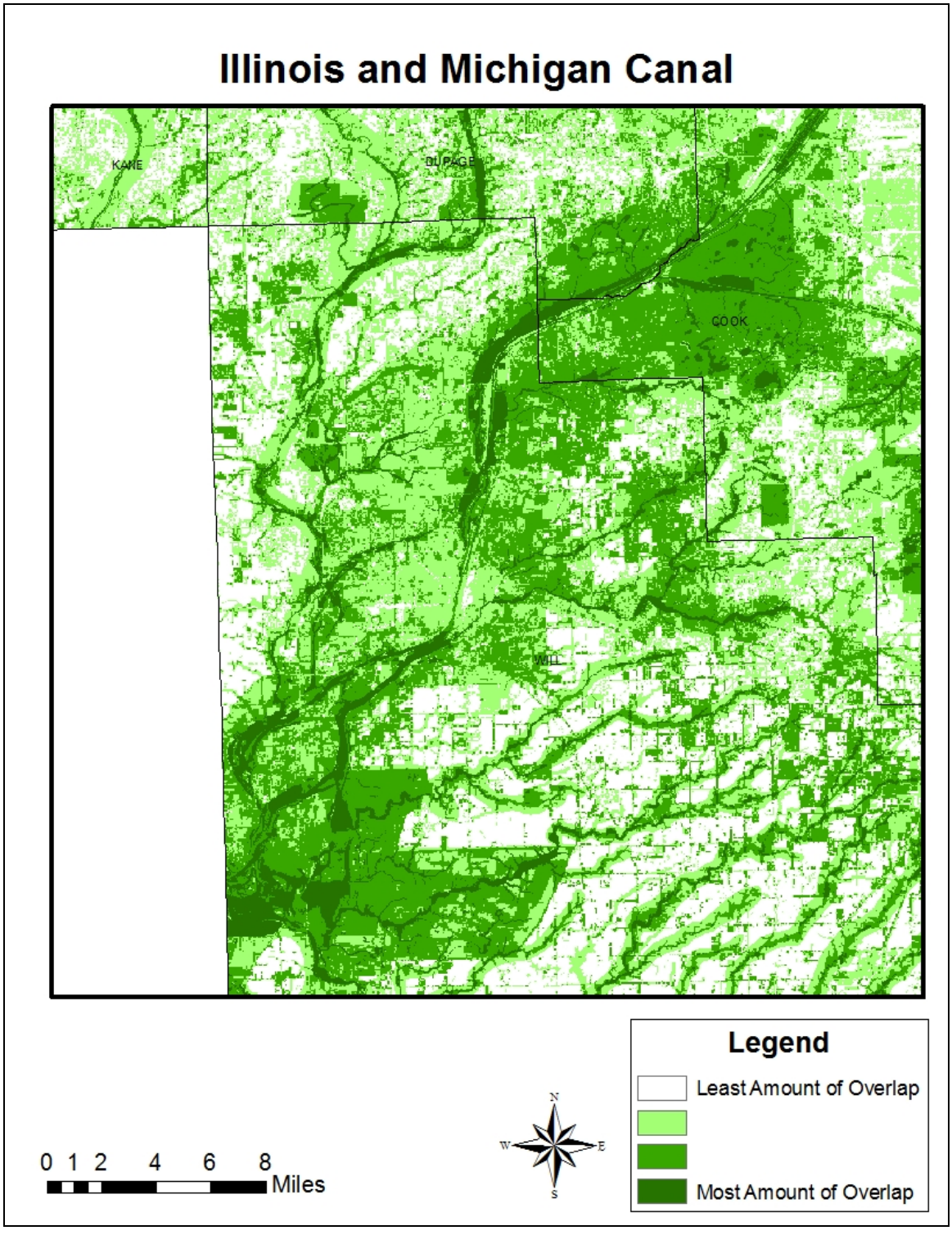

Figure 23: Illinois and Michigan Canal Overlap

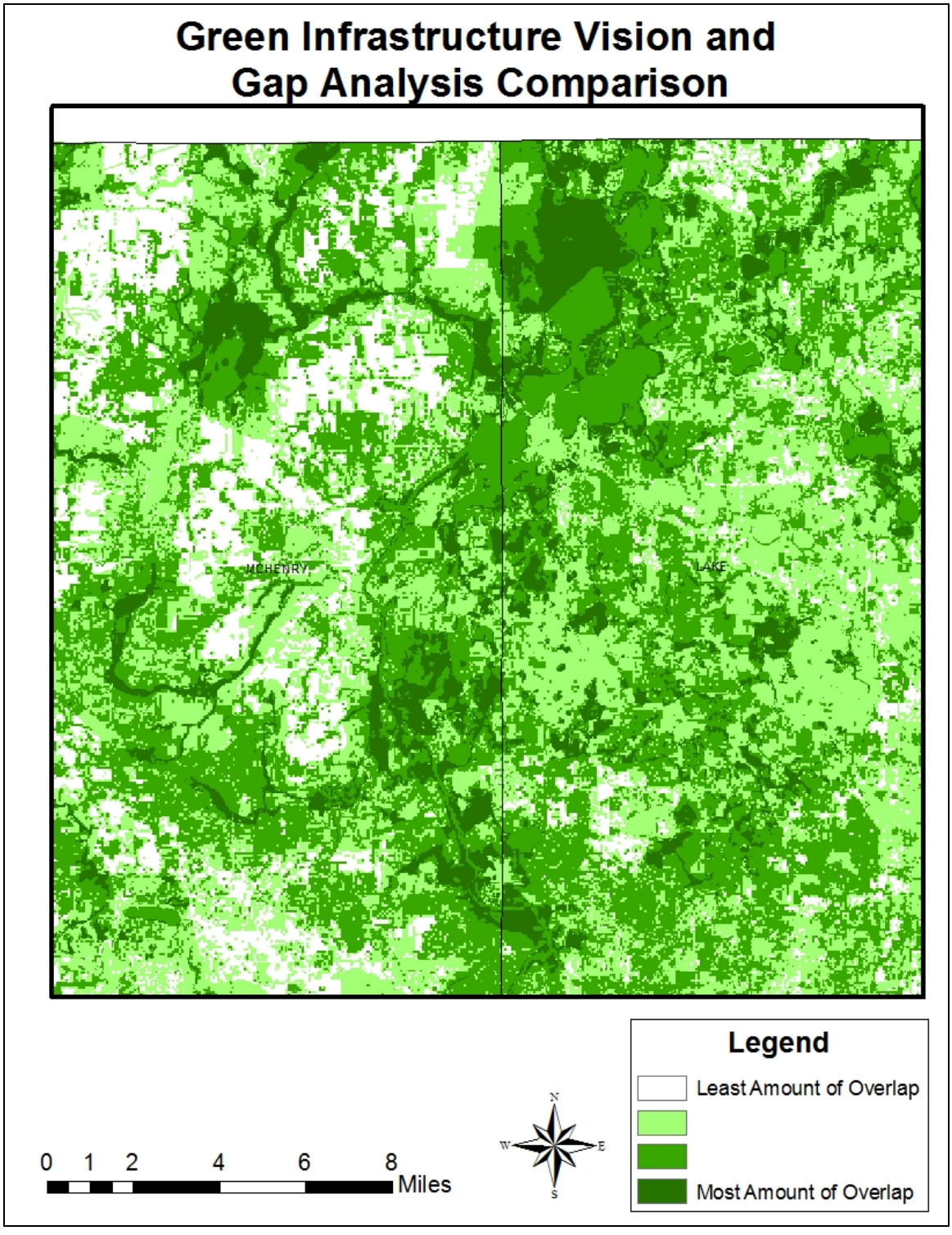

Figure 24: Northern Study Area Overlap

FINDINGS SYNTHESIS

The overarching interest of this study was to determine what roles, if any, planners play in the green infrastructure implementation process in regions with a highly urbanized city that has a population of over one million people. To examine these research questions, the survey was used as a tool to determine whether planners play integral roles in perpetuating the Chicago Wilderness Green Infrastructure Vision, and, if so, to what extent. Also of interest was and how planners contribute to the viability of the Vision, from a biodiversity perspective and whether or not they contribute to making green infrastructure visions functionally viable to wildlife.

To verify survey findings, area comprehensive plans including those drafted for the region, counties, and cities were reviewed. This was done to determine the extent to which planners of all levels are aiding the implementation of the Vision by writing the plans. To test the viability of the Vision's design, the gap analysis was performed utilizing the concepts of biodiversity preservation.

Planners' Involvement in Green Infrastructure Visions

To evaluate planners' involvement in green infrastructure visions, members from all survey paths were asked to evaluate how integral planners' roles are to its implementation. The Science, Planner, and Other survey paths were asked to rank their agreement with the statement, "Planners that are involved in the Chicago Green Infrastructure Vision have integral roles in creating, maintaining and perpetuating the vision" while the conservation land

path participants were asked to evaluate the statement, “Planners have integral roles in creating, maintaining and perpetuating networks of conserved land.”

The majority of respondents in all four paths agreed with their respective statements. Of those that were directed down the science path, 12 out of 16 scientists, or 75 percent of the path’s respondents believed that planners were involved with the Vision in some capacity. The planning path agreed the most strongly, having 20 out of 21 participants, or 95.2 percent, agreeing with the statement, eight strongly, eight moderately, and four mildly. Furthermore, 70 percent or seven out of 10 members of the other career field path agreed, five strongly and two moderately. Finally, of those respondents that were sent down the basic land conservation network path, 83.3 percent felt planners had a significant role in creating conservation networks with three strongly agreeing and two moderately agreeing.

Correlations were run between planners’ identified level of involvement in the Vision and both their opinions on the dependency of the Vision on planner participation and whether all levels of planners (city, regional, etc.) are involved. No significant correlations were found. When determining the relationship between planners’ self-identified levels of involvement in the Vision and their ranking of how dependent the Vision is on planners, there was an r-value of 0.507. This indicates that 25.7 percent of the answers on how important planners’ roles are in the vision can be attributed to the participating planner’s self-identified level of involvement in the Vision.

When exploring the relationship between the participating planners' levels of involvement and their opinion on whether different levels of planners are involved in the vision there was a weaker relationship. This generated an r-value of 0.105, This indicating that 1.1 percent of planners' opinions about whether planners in general are involved in the Vision can be attributed to their personal level of involvement in it.

These statistics suggest that planners that responded to the survey did not rate the involvement of other planners as it related to their personal level of involvement. The majority of participants in all four survey paths agree that the Vision is dependent on the participation of planners, with the planning path agreeing most strongly with the aforementioned statement. Therefore, it can be assumed that planners involved with the Vision were not biased because of their level of involvement when evaluating the participation of other planners, and confirms the validity of the strong agreement that the Vision is dependent on planner participation.

Furthermore, as previously mentioned, Chicago's GO TO 2040 Regional Comprehensive Plan specifically mentions in detail how the goals of Chicago Wilderness' Green Infrastructure Vision should be incorporated into regional planning objectives. Also, tactics to preserve biodiversity and lay the groundwork for creating a larger network of conserved lands are found in the aforementioned comprehensive plans from the study area.

Planners' Roles in Green Infrastructure Visions

The science, planner, and other career field paths were asked to identify specific ways in which planners have both aided and failed in implementing the Chicago Wilderness Green Infrastructure Vision. As previously mentioned 50.0 percent of scientists, 76.2 percent of planners and 60.0 percent of the other career field path stated that planners have aided in the implementation of the Vision through drafting of area comprehensive plans. This comprises 57.7 percent, or 30 out of 52 respondents that completed the full survey.

All three paths were also asked to identify how both city and comprehensive plans reflect the Vision. Although all three paths agreed that comprehensive plans were the most common way that planners aided green infrastructure implementation, each path differed on how the plans specifically reflect the Vision. The largest percentage of scientists, 43.8 percent, felt that city comprehensive plans were written with goals of green infrastructure in mind. However, 75.0 percent of planners felt that city plans reflected the vision by promoting private conservation approaches. Furthermore, 80.0 percent of participants in the other career field path felt that the plans contributed by designating networks of open space conservation lands.

These numbers changed when respondents were asked the same question of county comprehensive plans. The science path noted zoning and open space networks as the most obvious way that county comprehensive plans reflect the Vision, with 37.5 percent of the path's participants choosing these two categories. Likewise, seven out of nine, or 77.8 percent of the other path noted

designation of open space networks as a way these plans contribute to green infrastructure goals. However, 16 out of 18, or 88.9 percent of planners noted that both promotion of green infrastructure to stakeholders and promotion of private conservation approaches were the most obvious ways that county comprehensive plans reflect the Chicago Wilderness Green Infrastructure Vision.

When asked how planners have failed to promote the Vision, 75.0 percent of scientists, 12 out of 16, identified inappropriate or lack of zoning designations as the major issue. Planners also identified this as the most common way in which they fail the Vision with 12 out of 21, or 57.1 percent selecting it. A slightly lower number of the other career field paths chose this as an obstacle to the implementation of the Vision with four out of 10, or 40 percent, selecting it. Of the 52 participants that followed the survey to completion, 28, or 53.9 percent identified zoning as a way that planners have failed to promote the vision.

A correlation was run to test the relationship between the participating scientists, planners, and others level of involvement in the Vision and whether or not they chose the drafting of comprehensive plans as a way that planners have aided green infrastructure implementation in the Chicago area. An r-value of 0.024 was obtained, suggesting that less 0.01 percent of answers identifying comprehensive plan drafting as a way that planners have aided the Vision's implementation process can be attributed to the level of involvement of respondents in the vision.

Another correlation was run to test the relationship between the science, planner and other path's level of involvement in the Vision and whether they identified zoning as a way that planners have ultimately failed in its implementation. An r-value of 0.141 was obtained, suggesting that only 2.0 percent of responses identifying zoning as a way that planners have failed the green infrastructure implementation process can be attributed to participants' level of involvement in the Vision.

Therefore, participants' level of involvement in the Vision was not correlated to whether they chose comprehensive plans or zoning as ways planners have aided and failed in the promotion of its implementation, respectively. This suggests that opinions on how planners have contributed to green infrastructure in the Chicago area as far as comprehensive plans aiding and zoning designations impeding the process are not related to their individual levels of participation in the Vision. However, the amount of respondents that chose these options suggests that the most important role that planners currently play in the process is drafting comprehensive plans. Furthermore, planners could better implement the Vision by creating more receptive zoning designations.

As previously mentioned, area comprehensive plans were reviewed to check for implementation of the Chicago Wilderness Green Infrastructure Vision. The Chicago Metropolitan Agency for Planning as well as other county and city comprehensive plans do promote green infrastructure goals. Therefore, we can

assume that planners do play significant roles in the implementation of the Vision by drafting area comprehensive plans that reflect it.

Planners' Roles in Maintaining Biodiversity

The survey attempted to ascertain if planners are involved in making green infrastructure visions viable from a biodiversity perspective. The Likert Scale statements involving green infrastructure concepts were used to analyze this aspect of the research question. According to the survey, when asked to rank the statement, "Planners involved in the GIV want it to foster biodiversity more than human needs" seven out of 10, or 70.0 percent of respondents from the other career path agreed with the statement, while eight out of 16, or 50.0 percent of scientists agreed. However, when the scientists were asked to rank the statement, "Planners are knowledgeable about the importance of maintaining biodiversity" 10 out of 16 path respondents, or 62.5 percent agreed.

When asked to rank the statement, "I think that maintaining biodiversity is more important than other functions such as scenic value or human recreation when designating conservation land" the majority of planners, 19 out of 21 or 90.5 percent, agreed. Finally, when those in the basic land conservation networks path were asked to rank the statement, "Planners want to conserve lands to foster biodiversity", 100.0 percent, or six out of six respondents agreed with the statement.

Additionally, correlations were run to test planners' roles in maintaining biodiversity in the Vision and in general. One correlation was run to test the

relationship between the number of years of experience of participant planners and how they strongly they agreed or disagreed with the statement assessing whether they place biodiversity above anthropocentric needs in designating conservation lands. A significant r-value was not reached and less than 1.0 percent of planners' opinions on biodiversity can be attributed to their years of experience in their current position.

Another correlation was run to test the relationship between the level of involvement of scientists and other career field participants in the Vision, and whether they believe that involved planners place biodiversity over anthropocentric uses when contributing to the Chicago Wilderness Green Infrastructure Vision specifically. An insignificant negative correlation was found. An r-value of -0.096 was reached suggesting that as these participants' levels of involvement in the Vision increased, their belief that involved planners placed biodiversity over anthropocentric needs decreased, but only 1.0 percent of responses could be attributed to this relationship.

These results suggest that years of experience do not correlate to the intensity of planners' emotions about maintaining biodiversity when designating conservation land, which is a major component of designing viable green infrastructure visions. Furthermore, they suggest that the level of involvement of non-planner participants in the Vision does not correlate to their opinions of whether planners place more importance on designating functional conservation land, rather than structural. However, respondent answers suggest that planners

are knowledgeable of the importance of maintaining biodiversity and attempt to do so.

The prevalence of the Vision and basic green infrastructure concepts in area comprehensive plans suggests that planners do play a role in its implementation. Furthermore, from the gap analysis, it is apparent that the vision is successful in choosing the most important lands for conservation from a biodiversity standpoint. Because survey data suggests that planners often aid the program by drafting area comprehensive plans and designating conservation land, it can be assumed that planners do have a role in maintaining the biodiversity of the Chicagoland region by making the Chicago Wilderness Green Infrastructure Vision viable.

LIMITATIONS

The analysis of the survey results was limited by the response rate and participant delinquency after the initial demographic questions. Although all demographic respondents were taken into account to describe the study population's characteristics, the majority of the analysis was based on those respondents that completed the survey in full. Also, because the 17.1% response rate was lower than the ideal 25.0% or higher, statistics are not as reliable as desired.

Due to budgetary and time constraints, an internet-based survey was chosen because electronic surveys generally “have higher initial fixed costs but

limited marginal costs" (Kroth, et al., 2009, p. 247). This mode was also chosen because it has been identified as one of the easiest means of data collection (Parsons, 2007, p. 13). However, the mode choice could have had a negative impact on response rates and survey completion. Furthermore, there was an inability to control who answered the survey because contacts had the ability to forward the e-mail.

Finally, because of time constraints, no quantitative analysis was performed on the gap analysis. Because there is a wealth of spatial information available and the Vision has already been mapped, quantitative analyses are possible. This should be considered with future projects of this nature.

CONCLUSIONS

In summary, planners that responded to the survey did not rate the involvement of other planners in the Vision as it related to their personal level of involvement. But, the majority of all participant paths agreed that the Vision is dependent on the participation of planners, suggesting that planners do have some role in its promotion and/or implementation. This is confirmed upon review of area regional, county and city comprehensive plans based on the prevalence of the Vision and/or its goals within them.

Respondents also identified the drafting of comprehensive plans as the most common way that planners have aided the implementation of the Vision. Although opinions varied about how the comprehensive plans expressed the

Vision specifically. City comprehensive plans were said to promote the vision by touting the importance of both private conservation approaches and open space conservation systems. These were also common answers to how county comprehensive plans aid the Vision.

Combining this information with the fact that the majority of survey respondent's believed that planners are knowledgeable of the importance of biodiversity suggests that planners were involved in helping to promote the designation of conservation lands, both publicly and privately, in the study area. When looking at the gap analysis it is apparent that the Vision is functionally viable. This suggests that planners were involved with the vision, active in it by preparing area comprehensive plans that promote private conservation approaches and the conservation of open lands, and thereby have aided in making it a viable green infrastructure vision.

RECOMMENDATIONS FOR FUTURE RESEARCH

The implications of this research could be used to aid in the formulation and implementation of green infrastructure visions in other large cities such as Los Angeles, New York City and Washington D.C., despite the biological and ecological differences in the regions. However, when replicating this study for other large urban areas, there may be potential improvements to the research design. These include exploring different survey methods and survey promotion techniques, and incorporating more quantitative analysis of results specifically related to the gap analysis.

The survey response rate should be improved in future research on this subject. Based on the limitations of electronic survey distribution and the high propensity of respondents to fail to participate in the survey to its completion, other forms of survey distribution should be explored. Providing the survey through mail or a mixed-mode approach might have offered a better response among subjects. Another method that could be employed to improve future response rates would be to contact the director of green infrastructure visions in an effort to promote the survey. Official endorsement might have gleaned more results from the identified population.

Future study should also include a more quantitative evaluation of a gap analysis. The viability of green infrastructure visions from a biodiversity standpoint could be better proven than with simple qualitative analysis. The time constraints involved with this study prevented the completion of this analysis. However, the results are still viable and significant because the gap analysis verified the survey results and provided evidence of how planners have contributed in this Vision.

This study suggests that planners do contribute to the formulation, implementation, and viability of the Chicago Wilderness Green Infrastructure Vision. They do so by drafting area comprehensive plans, utilizing the concepts of green infrastructure in those plans, and designating functional conservation lands in the Chicagoland area. This research can and should be applied to other large metropolitan areas seeking to create viable green infrastructure visions and

should serve as a foundation for future research on how planners can contribute to the continuation and preservation of biodiversity.

APPENDICES

Appendix A: Email to Potential Participants

Hello,

My name is Kaylen Francis and I am a city and regional planning master's student in the Department of Planning and Landscape Architecture at Clemson University in Clemson, South Carolina. While completing my internship this summer I became acquainted with the Chicago Wilderness Green Infrastructure Vision and wanted to study it further in the hope that it will benefit green infrastructure visions in other cities. Therefore, I am asking that you participate in a 15 minute survey that is integral to the outcome of this research. The purpose of this survey is to collect information regarding green infrastructure plans in highly urbanized areas and to determine how planners are contributing to their implementation.

I have contacted you because the Chicago Wilderness non-profit indicated that your place of employment is involved in the development of the Green Infrastructure Vision and I hope that you will be able to give needed insight. If you believe that someone else in your organization is more qualified to answer the survey, please forward this cover letter and the survey link to them.

All responses are anonymous and aggregated, so they cannot be traced back to individual participants. Even if you are not directly associated with the Green Infrastructure Vision, your responses form the foundation of this research and all survey participants' organizations will have access to the findings. If you have any questions or concerns, please contact me kfranci@clemson.edu or the supervisor on this research project, Dr.Caitlin Dyckman at cdyckma@clemson.edu. Also, please print out the attached glossary of terms to reference during the survey.

Complete the survey online at the following link:

https://www.surveymonkey.com/s/2DSQRMF

Thank you for your help!!!

Kaylen Francis
Clemson University
MCRP Class of 2011
828-734-4813

Appendix B: Participant Glossary of Terms

Green infrastructure: networks of green space that conserve biodiversity and ecosystem health and functions, while also providing benefits to human populations.

Planners: For the purposes of this research study "planners" should be considered to mean any (and/or all) types of planners (e.g., city, regional, environmental, sustainability, etc.) unless otherwise stated.

Public Sector: For the purposes of this research study, the public sector refers to employment by the government.

Private Sector: For the purposes of this research study, the private sector refers to employment by private companies, non-profits, and any other non-governmental organizations.

Urban Growth Boundary: An urban growth boundary, or UGB, is a regional boundary, set in an attempt to control urban sprawl by mandating that the area inside the boundary be used for higher density urban development and the area outside be used for lower density development.

Chicagoland: The area around the city of Chicago. For the purposes of this research study, this should be applied to Cook, Lake, Kane, McHenry, Will, and DuPage counties.

Systems of conserved land: Interconnected networks of open space.

Appendix C: Green Infrastructure Survey

Page 1: Survey information (everyone)

For the purposes of this study, green infrastructure programs are defined as networks of green space that conserve biodiversity and ecosystem health and functions, while also providing benefits to human populations. This study is also interested in all levels of planners, from local to regional and those in both the public and private sector. These definitions should be kept in mind when answering survey questions. Also, please remember that all of your responses are anonymous and cannot be traced to you.

The survey should take approximately 15 minutes. If you have any questions or concerns please contact me by email at kfranci@clemson.edu or directly by phone at (828) 734-4813. You may also contact the supervisor on this research project, Dr. Caitlin Dyckman at cdyckma@clemson.edu.

Page 2: Demographics (everyone)

1. What is your job title? (fill in)

2. Please choose the answer that best describes your employment type. (multiple choice)
    a. Public sector
    b. Private sector

3. Please answer the following demographic questions about where you are employed. (fill in)
    a. City/Town
    b. State

4. For how long have you been employed in this position (and/or institution)?

Page 3: Green Infrastructure Familiarity (everyone)

1. Do you have experience with (and/or knowledge of) the Chicago Wilderness Green Infrastructure Vision? (multiple choice)
    a. Yes
    b. No (forwarded to basic green infrastructure questionnaire path)

Page 4: Career Field

1. In which career field is your current job most likely to be categorized? (multiple choice)
    a. Science (forwarded to science path)
    b. Planning (forwarded to planning path)

c. Other, blank to specify. (forwarded to other path)

Page 5: Science Path

1. Please respond to the following statements. (Answer matrix)
    a. I am/was involved in the Chicago Green Infrastructure implementation process.
    b. I have experience with (and/or knowledge of) city and planners' roles in the Chicago Green Infrastructure implementation process.

Strongly disagree/Moderately disagree/Mildly disagree/N/A/Mildly agree/Moderately agree/Strongly agree

2. If you do have experience with (and/or knowledge of) planners' roles in the Chicago Green Infrastructure implementation process, please describe the extent, character, etc. of their roles from your perspective (fill in).

3. Please respond to the following statements using your previous experiences and/or your opinions (answer matrix).
    a. Planners want the Chicago Green Infrastructure conservation lands to foster biodiversity more than human recreation or other anthropocentric needs.
    b. *Planners involved in the Chicago Green Infrastructure Vision* are knowledgeable about the importance of maintaining biodiversity.
    c. *Planners* are knowledgeable about the importance of maintaining biodiversity.
    d. *Planners involved in the Chicago Green Infrastructure Vision* are cognizant of the ecological footprint of the Chicago region and attempt to decrease it.
    e. *Planners* in both the public and private sector are cognizant of the ecological footprint of their regions and attempt to decrease it.
    f. *Planners involved in the Chicago Green Infrastructure Vision* are concerned with the need to link conserved habitats.
    g. *Planners* in both the public and private sector are concerned with habitat fragmentation.
    h. City comprehensive plans reflect the Chicago Wilderness Green Infrastructure Vision.
    i. County comprehensive plans reflect the Chicago Wilderness Green Infrastructure Vision.

j. *Planners involved in the Chicago Green Infrastructure Vision* aid in trying to formulate a network of private conservation land when needed.
k. *Planners* in both the public and private sectors aid in the formulation of a network of private conservation land when needed.
l. Planners that are involved in the Chicago Green Infrastructure Vision have integral roles in creating, maintaining and perpetuating the vision.
m. *Planners involved in the Chicago Green Infrastructure Vision* help develop strategies to conserve for future generations by promoting development that incorporates green infrastructure concepts (e.g., green roofs, compact development).
n. *Planners* in both the public and private sector help develop strategies to conserve for future generations by promoting development that incorporates green infrastructure concepts (e.g., green roofs, compact development).

Strongly disagree/Moderately disagree/Mildly disagree/N/A/Mildly agree/Moderately agree/Strongly agree

4. Would you like to clarify any of your answers to question 3? If so, please comment here. (comment box)

5. Please identify the ways that **city** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply).
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

6. Please identify the ways that **county** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply).
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

7. In your opinion, how have planners AIDED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

8. In your opinion, how have planners FAILED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Inappropriate or lack of zoning designations
    b. Little or no promotion of the vision to stakeholder groups
    c. No implementation of urban growth boundaries

d. Little or no promotion of the use of conservation easements and other forms of private land conservation tools.
e. Drafting area comprehensive plans that LACK the goals of the Chicago Green Infrastructure Vision.
f. Little or no promotion of land trust purchases
g. No cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
h. No designation of a contiguous network of open and conserved space
i. None of the above
j. Other (box to specify)

9. Would you like to clarify any of your answers to the previous two questions? (comment box)

10. Finally, what do you think planners of all levels could do to better promote green infrastructure visions? (comment box)

Page 5: Planner path

1. Please respond to the following statements. (answer matrix)
    a. I am/was involved with the Chicago Wilderness Green Infrastructure Vision.
    b. The Chicago Green Infrastructure Vision implementation is dependent on the participation of planners.
    c. Planners of all levels (city, regional, county, public sector and private sector) are involved in the Chicago Green Infrastructure Vision implementation process.

Strongly Disagree/Moderately Disagree/Mildly Disagree/Neutral or N/A/Mildly Agree/Moderately Agree/Strongly Agree

2. Please briefly describe your role, if any, in the Green Infrastructure process. (comment box)

3. If you **did not** have a role but have experience with (and/or knowledge of) the Green Infrastructure Vision, please briefly describe planners' roles, if any, in the program. (comment box)

4. If you **did** have a role in the Green Infrastructure process, please briefly describe your role in the Green Infrastructure Vision here. (comment box)

5. Please respond to the following statements. (Answer matrix)
    a. I think that maintaining biodiversity is more important than other functions such as scenic value or human recreation when designating conservation land.
    b. I have learned concepts of biodiversity through experience (and/or education).
    c. I think it is important to minimize the physical impacts and environmental degradation of a region.
    d. I try to create habitat links to larger areas of conserved land.
    e. **City** comprehensive plans contain elements of the Chicago Wilderness Green Infrastructure Vision.
    f. **County** comprehensive plans contain elements of the Chicago Wilderness Green Infrastructure Vision.
    g. I am willing to promote the formulation of a network of private conservation land.
    h. Planners that are involved in the Chicago Green Infrastructure Vision have integral roles in creating, maintaining and perpetuating the vision.
    i. I have helped develop strategies to conserve for future generations by promoting development that incorporates green infrastructure concepts like green roofs.

6. Please identify the ways that **city** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply). (Answer matrix)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space

i. None of the above
j. Other (blank to specify)

7. Please identify the ways that **county** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply). (Answer matrix)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

8. In your opinion, how have planners AIDED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

9. In your opinion, how have planners FAILED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Inappropriate or lack of zoning designations
    b. Little or no promotion of the vision to stakeholder groups

c. No implementation of urban growth boundaries
d. Little or no promotion of the use of conservation easements and other forms of private land conservation tools.
e. Drafting area comprehensive plans that LACK the goals of the Chicago Green Infrastructure Vision.
f. Little or no promotion of land trust purchases
g. No cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
h. No designation of a contiguous network of open and conserved space
i. None of the above
j. Other (box to specify)

10. Would you like to clarify or elaborate on any of your answers to the previous two questions? If so, please do so in the box below. (comment box)

11. Finally, what do you think planners of all levels could do to better promote green infrastructure visions? (comment box)

Page 6: Basic Green Infrastructure Questionnaire

1. Do you have any knowledge of (and/or experience with) systems designed to conserve land?
    a. Yes
    b. No (Disqualification message)

2. Please respond to the following statements. (Answer matrix)
    a. I am/was involved in the formulation (and/or promotion) of a system of conserved land.
    b. I am have knowledge of city, county and regional planners' roles in the formulation (and/or promotion) of a system of conserved land.

Strongly disagree/Moderately disagree/Mildly disagree/N/A/Mildly agree/Moderately agree/Strongly agree

3. Do you have experience with or knowledge of the roles of city, county and regional planners involved with the formulation (and/or promotion) of a system of conserved land? (multiple choice)
    a. Yes
    b. No (disqualification message)

4. If yes, please describe the extent, character, etc. of their roles from your perspective. (comment box)

5. Please respond to the following statements using your previous experiences and/or your opinions.
    a. Planners want to conserve lands to foster biodiversity.
    b. Local and regional planners in both the public and private sector are knowledgeable of the importance of maintaining biodiversity.
    c. Local and regional planners in both the public and private sector are trying to decrease the ecological footprint.
    d. Planners involved in land conservation systems are concerned with the need to connect conserved habitats.
    e. Planners are concerned with habitat fragmentation.
    f. City comprehensive plans reflect the need to conserve land.
    g. County comprehensive plans reflect the need to conserve land.
    h. Planners participate in the formulation and implementation of networks of private conservation land.
    i. Planners have integral roles in creating, maintaining and perpetuating networks of conserved land.
    j. Planners in my area help develop strategies to conserve a network of land for future generations by promoting development concepts like green roofs.

Strongly disagree/Moderately disagree/Mildly disagree/N/A/Mildly agree/Moderately agree/Strongly agree

6. Would you like to clarify any of your answers? If so, please do so in the box below. (comment box)

7. Please identify the ways that **city** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply). (Answer matrix)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.

f. Promotion of land trust purchases
g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
h. Designation of a contiguous network of open and conserved space
i. None of the above
j. Other (blank to specify)

8. Please identify the ways that **county** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply). (Answer matrix)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

9. In your opinion, how have planners AIDED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

10. In your opinion, how have planners FAILED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Inappropriate or lack of zoning designations
    b. Little or no promotion of the vision to stakeholder groups
    c. No implementation of urban growth boundaries
    d. Little or no promotion of the use of conservation easements and other forms of private land conservation tools.
    e. Drafting area comprehensive plans that LACK the goals of the Chicago Green Infrastructure Vision.
    f. Little or no promotion of land trust purchases
    g. No cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. No designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (box to specify)

11. Would you like to clarify any of your answers to the previous two questions? (comment box)

12. Finally, what do you think planners of all levels could do to better promote networks of conserved land? (comment box)

Page 7: Other path

1. In which career field is your current job most likely to be categorized? (multiple choice)
    a. Science (forwarded to science path)
    b. Planning (forwarded to planning path)
    c. Other, blank to specify. (forwarded to other path)

2. Please respond to the following statements. (Answer matrix)
    a. I am/was involved in the Chicago Green Infrastructure implementation process.
    b. I have experience with (and/or knowledge of) city and regional planners' roles in the Chicago Green Infrastructure implementation process.

Strongly disagree/Moderately disagree/Mildly disagree/N/A/Mildly agree/Moderately agree/Strongly agree

3. Do you have experience with or knowledge of the roles of city, county and regional planners involved with the Green Infrastructure Vision? (multiple choice)
    a. Yes
    b. No

4. If yes, please describe the extent, character, etc. of their roles from your perspective. (comment box)

5. Please respond to the following statements using your previous experiences and/or your opinions. Please remember your anonymity is guaranteed.(answer matrix)
    a. Planners want the Chicago Green Infrastructure conservation lands to foster biodiversity.
    b. *Planners involved in the Chicago Green Infrastructure Vision* are knowledgeable of the importance of maintaining biodiversity.
    c. *Planners* in both the public and private sector are knowledgeable of the importance of maintaining biodiversity.
    d. *Planners involved in the Chicago Green Infrastructure Vision* are cognizant of the ecological footprint of the Chicago region and attempt to decrease it.
    e. *Planners* in both the public and private sector are trying to decrease the ecological footprint of their regions of interest.
    f. *Planners involved in the Chicago Green Infrastructure Vision* are concerned with the need to link conserved habitats.
    g. *Planners* in both the public and private sector are concerned with habitat fragmentation.
    h. City comprehensive plans reflect the Chicago Wilderness Green Infrastructure Vision.
    i. County comprehensive plans reflect the Chicago Wilderness Green Infrastructure Vision.
    j. *Planners involved in the Chicago Green Infrastructure Vision* aid in the promotion of a network of private conservation land.
    k. *Planners* in both the public and private sector aid in the promotion of a network of private conservation land.
    l. Planners that are involved in the Chicago Green Infrastructure Vision have integral roles in creating, maintaining and perpetuating the vision.

m. *Planners involved in the Chicago Green Infrastructure Vision* help develop strategies to conserve for future generations by promoting development that incorporates green infrastructure concepts like green roofs.
n. *Planners* in both the public and private sector develop strategies to conserve for future generations by promoting development that incorporates green infrastructure concepts like green roofs.

Strongly disagree/Moderately disagree/Mildly disagree/N/A/Mildly agree/Moderately agree/Strongly agree

6. Would you like to clarify any of your answers? (comment box)

7. Please identify the ways that **city** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply). (Answer matrix)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

8. Please identify the ways that **county** comprehensive plans reflect the Green Infrastructure Vision (mark all that apply). (Answer matrix)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases

g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
h. Designation of a contiguous network of open and conserved space
i. None of the above
j. Other (blank to specify)

9. In your opinion, how have planners AIDED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Zoning designations
    b. Promotion of the vision to stakeholder groups
    c. Implementation of urban growth boundaries
    d. Promotion of the use of conservation easements and other forms of private land conservation.
    e. Drafting area comprehensive plans that include the goals of the Chicago Green Infrastructure Vision.
    f. Promotion of land trust purchases
    g. Cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. Designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (blank to specify)

10. In your opinion, how have planners FAILED in the Green Infrastructure implementation process? Mark all that apply. (Multiple answer)
    a. Inappropriate or lack of zoning designations
    b. Little or no promotion of the vision to stakeholder groups
    c. No implementation of urban growth boundaries
    d. Little or no promotion of the use of conservation easements and other forms of private land conservation tools.
    e. Drafting area comprehensive plans that LACK the goals of the Chicago Green Infrastructure Vision.
    f. Little or no promotion of land trust purchases
    g. No cooperation with other governmental bodies to protect endangered and threatened species in the Chicagoland area.
    h. No designation of a contiguous network of open and conserved space
    i. None of the above
    j. Other (box to specify)

11. Would you like to clarify any of your answers to the previous two questions? (comment box)

12. Finally, what do you think planners of all levels could do to better promote green infrastructure visions? (comment box)

Page 8: Thank you (everyone)

Thank you for participating in this survey! Please contact Kaylen Francis at kfranci@clemson.edu or (828)734-4813 if you have any questions or concerns. A summation of the survey results will be available to participants after completion of the study.

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